THE

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THE RECENT TRAMWAY ACCIDENTS.

DURING the Coroner's inquest into the cause of the deaths which followed the accident at Halifax some unfortunate facts came to light. First of all, a point cleaner admitted that he made the rails greasy by flushing them with water but not brushing them afterwards as was his duty. Secondly, the evidence showed that a wire in the controller had fused, that probably being the cause of the station circuit-breaker opening; and the driver admitted that he used the controller in the wrong way, but explained that two different controllers were fitted on the car, and he forgot which one he was working.

Col. Druitt, R.E., held an inquiry *in camera* on behalf of the Board of Trade two days before the inquest, and we imagine that his report will make clear exactly what started the accident, and whether the short-circuit in the controller would have prevented the motorman using the electric brake even if he had handled the controller properly. Undoubtedly the fact that the controllers were of different patterns will draw from him the censure which is merited if the method of control by each was really sufficiently different to make confusion possible. The jury were of opinion that the management were sadly to blame in sending out a car equipped in that manner, but one of the witnesses—a prominent local engineer—gave evidence that, from the appearance the brakes presented, the driver must have applied them in the right way.

Colonel Druitt's report on the Bradford accident, which occurred on July 31st, has been issued. In this accident the car turned over, and one of the axles was afterwards found broken.

The Inspector thinks that the fracture, whether it happened when the car was rounding the curve before the steepest part of the hill was reached, or later on when the car overturned, was not actually the cause of the runaway, but that the driver might have descended the hill in safety even with a broken axle if he had applied the slipper brake at the top of the hill, instead of waiting until the wheel brake and the electric brakes were rendered almost useless by the axle breaking, and a speed had been attained at which no slipper brake could have any effect.

"What is required," he says, "for cars on steep gradients, is a mechanical slipper brake which can be applied practically instantaneously, as once a car gets out of control on a steep gradient, it is impossible to stop it with the brakes at present in ordinary use." He adds: "There are some mechanical brakes under experiment at present which can be applied instantaneously, and it is to be hoped that the committees which are considering this question will be able to recommend shortly the adoption of a pattern of such a brake."

These are our feelings entirely, and we believe that Col. Druitt had in his mind when writing his report the brake to which we referred in a leading article and in a table of tests on April 19th last. Since that date the inventor of the brake has not been idle, and he informs us that further tests have put the brake in a still more favourable light; for instance, when applied to a car running free at 13·75 M.P.H. on a falling grade of 1 in 12, the stopping distance was 55 ft., and at 18·5 M.P.H. on 1 in 20, the distance was 88 ft., the rates of retardation being respectively 3·67 and 4·53 ft. per sec. per sec.

Things have come to such a pass now that very strong pressure is sure to be put upon all tramway undertakers to

force them to adopt any brake which the Committees now in session consider likely to fulfil all the essential conditions attaching to the action of an emergency brake, and we were always sure that directly an imperative demand was made the right brake would be forthcoming. Quite possibly there are several, but at present we know of one only which complies with the strict conditions which we have laid down.

The Limerick Competition.

Mr. Gallinagh having resigned his appointment as borough electrical engineer to the Corporation of Limerick, the Electric Lighting Committee sat for three days to consider the qualifications of 120 applicants for the post, which, by the way, is worth £160 per annum.

Quite a number of the applicants were electrical engineers, either by accident or design, and could not even sign their names in the Gaelic, which even the newest Sinn Feiner can do, if given time and a pattern to go by. What these gentlemen were doing in Limerick no one can tell, and we merely surmise that they were ignorant of the elementary rules of the competition, which are, in English, as follows :—

Every candidate

(i) Shall have been made throughout in Ireland, south of the Boyne ;

(ii) Shall not have left Ireland, except to go to America when the potato crop failed.

(iii) Shall agree to die in Ireland, and be buried at the expense of the Saxon invader.

Mr. Patrick Thomas MacNamara (it is something much longer and quite different in Gaelic) was elected. He is a Member of the Engineering Association of Ceylon, and he wrote a lot of Gaelic in a copy-book quite a number of years ago. What more suitable man could there be to run an over-loaded gas-engine station which supplies a busy town with light and power ?

During a somewhat humorous discussion, in which the Mayor's Serjeants lent a hand, one of the Committee was rash enough to say that he did not think any member of the Council was qualified to give a decision on any of the candidates for the position, and expressed an opinion that a man who thoroughly understood the business ought to be appointed. If this gentleman had only taken the trouble to make himself acquainted with the rules, he would have been spared the ridicule which was hurled at him amidst general merriment. He should have known—really, we blush for his ignorance—that a knowledge of the business had nothing to do with the matter, the really important attainments being an ability to find one's way about a town in which the names of the streets are set up in Gaelic, and an unswerving loyalty to Limerick bacon.

We congratulate the Corporation of Limerick upon the magnificent way in which they rejected all advances from electrical engineers, and we trust that one or two stalwarts from the Committee will be present when Mr. MacNamara undergoes his examination at the hands of the electrical engineer of Cork, to see that all questions are asked in Gaelic, answered in Gaelic, and are all about Gaelic.

Ended in Smoke.

The acquittal of the Underground Electric Railways Co. of London, Ltd., on the charge of permitting black smoke to issue from their chimneys, seems to mark a new era in the history of London's smoke. Not only was the company exonerated, leaving the Court without a stain on its character, but also the magistrate, Mr. Curtis Bennett, mulcted the Chelsea Borough Council in costs to the tune of 300 guineas, and expressed his sympathy with the company.

It appears that this result was arrived at by reason of the lack of scientific evidence on the side of the Borough Council as to the precise quality of the emission from the company's chimneys. The smoke, in the magistrate's opinion, was not as black as it was painted by the prosecution ; it was, in fact, only dark brown. This murky vapour, arising from cavernous craters each no less than 19 ft. in diameter, might have appeared to the uneducated eye as black ; but in reality its depth was merely due to its thickness.

The debt of gratitude which London owed to a company which had caused underground traffic to be worked by electric power, saving millions of passengers from the stifling atmosphere of the tunnel under the old system of "smoke trains," was brought into the argument, though, as a matter of fact, it was not the defendant company that conferred this benefit upon London, but the two Metropolitan companies under compulsion by Parliament. Moreover, Mr. Bennett and the prosecution agreed that the works at Lot's Road, Chelsea, were as perfect as science could make them—and they ought to know.

We do not quarrel with the verdict ; although the Chelsea chimneys may be responsible for no inconsiderable output of solid particles, it must not be forgotten that they have to deal with an immense development of power, and that in all probability the amount of the fumes that they discharge at a great height in the West End is far less than that formerly distributed amongst the London streets by the "smoke trains." Moreover, in view of the compulsory electrification of the railway, and the statutory powers of the company, it is, as we have pointed out on a previous occasion, unfair to take a harsh view of the behaviour of the chimneys. The company is to be congratulated upon its victory.

Wiring Systems.

The battle of the systems does not yet appear to be settled, and scarcely a week passes without some correspondence appearing in one or other of the technical or trade papers, discussing the pros and cons of casing, tubing, lead-covered wiring, or flexible wiring systems. There is, we think, no doubt that for the better classes of work the screwed piping system, or an equivalent, will prevail. By "equivalent" we mean a piping system in which the joints are mechanically made in such a manner as shall preserve complete electrical continuity. Wood-casing work has little beyond its cheapness to recommend it, and even this is not a great consideration where skilled joiners or carpenters are employed.

Among the influences which have been at work to oust the wood-casing method of enclosing wires, has been the action of the Joiners' and Carpenters' Societies, who objected to the mere wireman posing as a joiner, or, at any rate, doing work which they considered to be their monopoly. A trade union joiner is a well-paid man, whether he be good, bad or indifferent at his work, whereas wiremen are paid very largely according to ability. The tendency has been, therefore, towards the evolution of a system in which the whole of the materials, whether the cables or the casings, could be handled and erected by wiremen, and this naturally means the supersession of wood.

From the point of view of mechanical strength and safety from shock or fire, experience appears to favour the solid piping system. Whilst, therefore, there may still be a field for wood casing in low-voltage work, or in cases which lend themselves particularly to a wood-casing installation, our feeling is that the system which will survive will be a system in which continuous metallic tubing is used. We feel, too, that if the general opinion of the trade could be obtained as to the best system of protecting wiring, regardless of expense, this opinion would be almost unanimously in favour of metallic tubing.

Factory Lighting.

An article by Mr. J. T. Kermode in a recent issue of the *Western Electrician*, shows that undoubtedly the demand for a higher standard of artificial illumination for factories and workshops is rapidly increasing. The short hours of use and the heavy demand on the station peak have brought about a condition where there is some question as to the

advisability of factory lighting on its own merits alone from a supply company's standpoint; it is, however, very important when combined with the supply of power.

The average factory requires artificial light during 10 to 20 per cent. of its working hours, not including overtime or night-shift, therefore the illumination should be sufficient, and the lamps so arranged that the quality and quantity of the work accomplished during these hours can be as well and as economically done as that which is performed by day-light. The amount of light required varies, of course, with the general shop conditions, and the character of the work to be done.

We have been taught by experience that no general rule can be laid down to govern the many different situations that present themselves. The lighting of each particular factory must be carefully studied to give the best results. In foundries, steel mills, and the like, where the walls are dark, and the work does not require concentrated light, a lamp is needed that will give good general illumination. Enclosed arc lamps giving bright patches of white light, combined with shadows are undesirable for this class of work, as the dark walls and the dense atmosphere absorb a large percentage of the penetrating power. Flame arcs, in spite of heavy carboning costs, are being used considerably for lighting in large areas.

The use of higher candle-power arc lamps for factory lighting is rapidly increasing, and the advantage that can be obtained by their use and efficiency must be recognised, although it must be conceded that, if practical, the best illumination (*i.e.*, most uniform) is obtained by spreading a large number of small units of light over the area. In machine shops it is common practice, together with large units for general illumination, to furnish each workman with a single incandescent light, which, when new, and at average height from his work, usually gives a fair amount of light. Oil and dust soon reduce the illumination to one-half. In shops of this description where lathes, drill presses, planing machines, &c., are used, good general illumination of uniform intensity is required. Nernst or Gem lamps are well adapted for this class of lighting.

The size and number of lamps to be used depends upon the size of the room, height of ceiling, colour of wall, location of machines, belts and shafting. In estimating the size and number of units it might be of service to consider 50 watts per operator, or machine, as an average amount for all ordinary machine work and general illumination. For special machines or work that needs bright light, individual incandescent lamps with reflectors should be used. The general evenness of illumination, with the absence of glare, together with the slight shadow and the searching quality of the light produced by mercury-vapour lamps, makes them especially adaptable for factory lighting by direct current. Manufacturers of clothing require an even, shadowless, well diffused light of considerable brilliancy. Nernst lamps with prismatic reflectors can be utilised for this purpose with a comparatively low consumption per operator.

The difficulties that exist in factory lighting are familiar to all men engaged in the sale of electricity for power purposes, and it should be the duty of each central station manager to educate his men to successfully overcome these conditions by encouraging the use of lamps, shades and reflectors that have been produced for scientifically converting wasted energy into useful light. Recent discoveries and developments indicate that the practical efficiency of the electric lamp will be doubled in the near future, not merely by the use of new filaments, but by the scientific application of the laws of illumination in a common-sense manner.

Without a doubt industrial plants can be lighted by electricity in a satisfactory manner, and at an expense that will compare favourably with any other form of illumination, provided the equipment consists of units of the highest efficiency, installed according to modern practice. Electricity supply companies should devote more time to practically demonstrating to manufacturers the advantage to be derived from the use of higher efficiency units, with the idea of introducing a more intelligent mode of factory lighting as a valuable factor in assisting to secure and retain power business.

MODERN GAS-PRODUCER AND GAS-ENGINE PRACTICE.

By AN ENGINEER.

Now that internal combustion engines are so seriously entering into competition with steam for the development of electrical energy in power stations and other fields, it is essential that electrical engineers should be well posted up in regard to the principal details which go for guaranteeing the success of gas power installations.

Several gas-driven stations have been planned and put into operation, and in some cases very considerable extensions have followed upon the original designs, indicating, apparently, that the plant was all that could be desired, but, even after such repeat orders, steam power has finally been reverted to in not a few instances. The reason why steam has managed in some instances to oust its rival, is not due to the gas installation failing to fulfil its claims for economy in fuel and high thermal efficiency, for these are well proved in the many successful existing gas power stations, but to detail faults which extended experience is gradually mastering.

Much more valuable information making for success is to be obtained from plants that have proved faulty than from those which are satisfactory from the first, and it is only by carefully noting the points where faults of design or weakness of constructional detail may be expected, that engineers will be able to select the most suitable producer and gas engine, out of those offered by the various manufacturers.

In this connection the well-known engineer, Mr. R. E. Mathot, has contributed to the *Engineering Magazine* for June and July a couple of articles dealing with the main points of design and construction of modern producers and gas engines, which will be of practical value as a guide in examining proposals and selecting plant.

Mr. Mathot claims that considerable changes in regard to constructional details of gas engines have been brought about by the introduction of experience obtained with large steam engines, but although the valve gear has by some firms been made somewhat on the lines of steam practice, the writer is of opinion that the general improvement in gas engine construction is the result of experience gained with this type of motor itself rather than from steam practice; the high temperatures developed and the stresses set up under conditions differing largely from any met with in steam practice, with a hot dry medium only in the cylinder, have required different treatment, while the want of success of high-speed gas engines of the vertical type may possibly be due to endeavours to follow the lines of steam practice. To the writer's knowledge, experienced steam engine makers have turned to the gas engine for assistance in regard to the matter of piston rings, while attempts to introduce valves, other than the mushroom mitre valve, for gas engines have not been successful, the only other types of valve found to give good results being those designed on the basis of the gas engine piston, having a suitable number of rings associated with a fairly long plain portion.

Mr. Mathot, in referring to the necessity of ensuring steadiness, says this is obtained by massive frames which can be firmly fixed to the foundations, but the writer would point out that balancing the reciprocating parts is a very important factor in this respect.

Cyclic regularity in gas engines can only be improved by increasing either the weight of the fly-wheel or the number of impulses, so that, as nearly all large-power engines for electric generator driving must have fair cyclic regularity, this is most satisfactorily attained by increasing the number of cylinders. While a single-cylinder engine, working on the Otto cycle, may be provided with a fly-wheel weight to give a certain regularity, the addition of a second cylinder of equal power would double the power of the engine without necessitating any increase in either the crankshaft proportions or the weight of fly-wheel; two more cylinders could further be applied, doubling the power again under the same conditions, if they were properly arranged.

The author, further comparing steam and gas engines, says that, in the case of making the cylinder double-acting, there have been difficulties with large stuffing-boxes as in

the long experience of steam engineers; however, considering how short a time the double-acting gas engine has been under experiment, it would appear that the latter has got over the difficulties very much more quickly than its older rival. For a gas engine piston to give good results, it is essential that there should be *a number of piston rings associated with a fair length of plain barrel*, and if a similar principle is applied to stuffing boxes, good results are obtained.

Referring to the arrangement of the valves, as in the steam engine, at the end of the cylinder, Mr. Mathot says that placing the exhaust valve at the bottom causes it to act as a "drain for waste oils," but it need hardly be pointed out that owing to the high temperature of the combustion chamber during working conditions, an excess of oil should be carefully avoided, while any tarry matter, or fume, as with blast-furnace gas, which is permitted to enter the combustion chamber, accumulates in a hard scale on the exposed surfaces.

Continuing the comparison of gas with steam, Mr. Mathot says "It must be confessed that safety in working, facility of control, and cheapness of upkeep are, so far, much better realised in the steam engine than in the modern gas engine." As regards the question of repairs to gas engines, trouble frequently arises from inertia effects, in the writer's opinion; where there are a number of parts rapidly reciprocated by cams and springs, the moving parts should be as *light as possible* and the springs *only as strong as is absolutely necessary*.

For all gas engines above 20 H.P., as well as for any engine using producer gas, the author advocates electro-magnetic ignition; the point of ignition should be controllable, and for engines above 100 H.P. he prefers two independent ignition devices.

In the important matter of crankshafts, engineers will, no doubt, take exception to the design illustrated by Mr. Mathot; he says that "the shaft at the journals should be provided with a projecting ring, machined in the metal and acting as oil catcher," but the sharp V shown, combined with the increase in the distance between the crank cheek and the bearing, would have a tendency to reduce the safety of the shaft; in fig. 1 the full lines show Mr. Mathot's

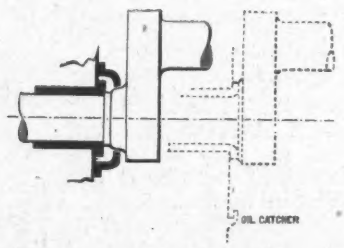

FIG. 1.

arrangement, and the dotted lines that advocated by the writer, for with steel shafts it is advisable that any change of shape should be free from sharp corners and have a fillet of fair radius.

The air inlet passages, Mr. Mathot says, should be so arranged that no nuisance is caused by noise or whistling, and in many instances, manufacturers provide an air-silencer similar to that for the exhaust.

In regard to the bed frame, Mr. Mathot advocates holding-down bolts carried right through the casting, in preference to employing lugs, and advises the provision of an oil-collecting groove at the base; also the cylinder jacket should have the least possible over-hang. For cams and rollers, Mr. Mathot says, "these should be made of cast-iron, or of the best hard-quality steel. They should be case-hardened $\frac{1}{16}$ in. deep, and mechanically rectified." Now, this sentence appears to be somewhat mixed up, for if the cams are of cast-iron, how can they be *case-hardened*? Some time ago, the writer visited a works where gas engines were constructed, and where they practised the case-hardening (?) of cast-iron cams; he drew attention to the fact that as cast-iron was already saturated with carbon, it would be of no value to attempt to add further carbon by means of the case-hardening process, and on testing the hardness of the cams before and after *case-hardening*, no increase in hardness was found to result. When best hard-quality steel is employed, ordinary hardening, not case-hardening, is all that is required.

In saying that "bearings and guides should be bushed with brass or babbit metal . . . . and should permit of easy adjustment for wear and tear," Mr. Mathot, perhaps, hardly gives the subject the consideration it merits.

Owing to the high stresses set up at the point of explosion of the charge, coupled with the speed of revolution, the proportions of the bearings very considerably exceed those suitable for steam practice, and in gas engines of large power the provision of gun-metal bearings becomes a serious item of cost; also it is necessary for the bearings to be always maintained a good fit, to prevent knocking. It is good practice, therefore, to make the bearings of cast-iron or steel shells, with only a thin lining of anti-friction metal, arranged so as to be readily renewable. This is the type of bearing

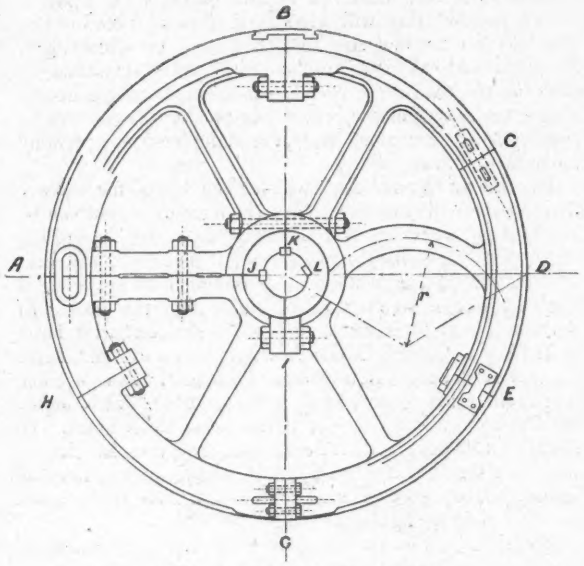

FIG. 2.—RIM AND BOSS JOINTS.

Mr. Mathot advises for the big-end of high-power engine connecting rods, and for the gudgeon-pin end he rightly advocates a solid end, cut out for the fitting of bronze bushes, owing to accidents which have resulted from the breaking of bolts at this point.

Referring to cylinder heads, Mr. Mathot prefers independent water cooling for high compression and cylinders of large diameter, and that large openings into the water jacket should be provided for the removal of the core material, and for cleaning purposes.

In this connection it is necessary, in order to ensure a sound casting, so to arrange the coring that efficient ventilation is provided for the escape of gas and moisture during the casting operation.

In gas engine practice the efficient lubrication of the different parts is of great importance, and for large units forced positive lubrication is much the best; for the cylinder it is not only necessary to ensure good lubrication, but an excess of lubricant must be carefully avoided. For engines ranging from 25 to 30 H.P., Mr. Mathot advocates ring lubrication for the main bearing, but this adds somewhat to the cost, and is not usually adopted except for larger engines; chain lubricators in some cases take up less room.

Mr. Mathot advises five piston rings for engines below 20 H.P., and six rings for higher powers, but in the case of pistons for internal combustion engines, these rings should be associated with a sufficient length of plain barrel, closely fitting the cylinder liner.

For the proportions of bearings, to prevent heating and wear, Mr. Mathot gives the following data. Taking the initial explosive pressure upon the piston at 350 lb. per sq. in., the intensity of thrust when considered on the diameter of the bearing multiplied by the length may be :—

Piston pin	3,000 lb. per sq. in.	
Crankshaft journals ...	600	„
Crank pin	1,600	„

In regard to governing, Mr. Mathot says this should be effected by a centrifugal type of governor, driven, by preference, by worm gearing, and capable of regulating the fall of speed between full and no load within 5 per cent. when regulation of the charge is on the system of variable admission of a constant ratio of mixture, which he advocates for large power cylinders.

The heavy fly-wheel necessary to provide a cyclic regularity suitable for driving electric generators has received a good deal of attention from manufacturers, and several designs are on the market, varying in regard to the strength of the joints in the rim and boss, as will be seen from the diagram, fig. 2, where five types of rim joints and three types of boss joints are given; of these the Crossley patent rim joint B is claimed to be equal in strength to a solid rim, while in the other types the strength varies from $\frac{1}{3}$ to $\frac{1}{4}$.

Mr. Mathot gives the allowable amount of variation in a single revolution of the fly-wheel for driving electrical generators as—

For electric lighting, continuous current $\frac{1}{50}$ to $\frac{1}{80}$.

For alternating-current generators in parallel $\frac{1}{150}$.

As the weight of fly-wheel to be provided is dependent upon the number and arrangement of the power strokes, the

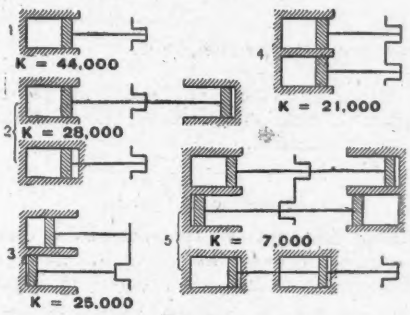

Fig. 3.

diagram, fig. 3, must be consulted in connection with the following formula by Mr. Mathot :—

$$P = K \frac{10{\cdot}75\ N}{D^2\ a\ n^3}$$

where P = the weight of the rim (without arms or boss) tons
D = dia. to centre of gravity of rim section in feet.
a = the amount of allowable variation.
n = number of revolutions per minute.
N = „ brake horse-power.
K = coefficient varying with the type of engine.

(1) K = 44,000 for 4-cycle, single-cylinder, single-acting.
(2) K = 28,000 „ two opposite cylinders, single-acting, or one cylinder double-acting.
(3) K = 25,000 for two cylinders single-acting with cranks at 90°.
(4) K = 21,000 for two cylinders, single-acting.
(5) K = 7,000 for four twin opposite cylinders, or two tandem cylinders, double-acting.

The total weight of the fly-wheel is P × 1·4.

In regard to the fuel employed to drive internal combustion engines, it is now well proved that the thermal quality of the combustible gas can vary within a very considerable range, so long as it is constant, as will be seen from the following table of gaseous fuels :—

	Thermal value per cb. ft. at 60° F. and 30 in. bar.	
Natural gas	1,000	B.TH.U.
Coal gas	650	„
Coke-oven gas	500	„
Producer gas	150	„
Blast-furnace gas...	100	„

The element of cost is, however, a controlling factor in all commercial applications, and the object of the gas engineer is to perfect the gasification of the cheapest class of fuels, of which the most abundant and cheap class consists of bituminous coal slack.

While the gasification of fixed-carbon fuels has reached such an advanced stage, that a certain amount of standardisation in the design of apparatus has become possible, the great variation in the chemical and physical composition of bituminous coal from different districts necessitates specialisation of apparatus to suit the locality. It may almost be said that some classes of bituminous coal cannot be satisfactorily gasified, and others approaching the non- and semi-bituminous classes can be employed fairly easily.

Mr. Mathot classifies producers as (1) pressure and (2) suction, of which the former are the more complicated, and are accompanied by a certain amount of danger from the possibilities of escape of carbonic oxide gas and accidental explosions. Grouping producers generally, the three essential parts are given as (1) generator, (2) vaporiser, (3) purifier, and the author first deals with fixed-carbon fuels. Dealing with the charging hopper for admitting fuel into the generating chamber, Mr. Mathot does not approve of those in which the outer cover can be entirely removed, preferring its being attached by a hinged joint—the essential feature being a gas-tight double seal. The usual practice is to have the sides of the generator chamber of the same diameter from the top to the grate, and the style of grate depends upon the content of ash in the fuel; a grate of basket shape offers a large surface and air passages more suitable for high ash fuel than the ordinary horizontal type, which answers well for small ash contents.

Referring to the air and steam employed for gasifying the fuel, Mr. Mathot says, "the higher the temperature above the grate, the richer is the gas produced. The most rational and most efficient means of securing this high temperature is to superheat the mixture of air and steam—the heat employed for the superheating should be obtained exclusively from gas which has passed out of the producers, &c."

However, the writer would point out that the principal advantage to be derived from the use of steam is to keep down the temperature of the grate, so as to prevent the formation of clinker and preserve the grate from deterioration, and as the chemical action which accompanies the reduction of temperature through the decomposition of the steam enriches the gas, this method is economical; otherwise the use of air alone would not only provide the heat, but also generate a gas almost free from hydrogen and very suitable for internal combustion engines. The combustible portion of this gas would consist almost entirely of carbonic oxide, which would allow of high compression pressure being employed with its accompanying economy in thermal efficiency.

In producers designed for the gas to escape into the annular space surrounding the charging hopper, the speed of discharge of gas is reduced, but there is the possibility of air passing up the walls of the generator without sufficient contact with the incandescent fuel, so Mr. Mathot prefers the method of taking off the gas centrally.

Most engineers will agree with the author as to the advantage of having poking holes, by means of which the fuel may be stirred and prevented from hanging, as well as the advisability of *all* joints being absolutely gas-tight, for while in suction plants the normal pressure in the gas apparatus is below that of the atmosphere, and any leak would be inwards, this is not the case during the *blowing-up* period.

In regard to the firebrick lining of the generator, it is pointed out that this should be so designed that ordinary stock sizes of bricks can be used. Touching upon vaporisers, these may be either of the internal or external independent type, but where the water is liable to deposit scale, upon boiling, facilities for cleaning are a necessity, and for this reason Mr. Mathot deprecates the use of Field tubes if impure water only is available.

While the gas from pressure types of producers can be purified in suitable apparatus, that from suction producers is usually only passed through one or more scrubbers, and the author points out the advantage of providing the scrubber with a charging door which is readily removable, so that fresh coke can be added and the dirty portion removed through suitable openings.

Mr. Mathot says that suction producers should be provided with a gas reservoir in the piping system between the scrubber and the motor, but the writer has found that this is

not always necessary, as there is generally a space of considerable capacity in the scrubber which serves the purpose, while the reservoir usually provided, and fitted with a draining cock, occasionally leads to trouble through the cock being left open; generally speaking, the fewer the number of cocks the better.

In regard to all piping through which gas not entirely free from dust is to be passed, Mr. Mathot advises tees or crosses at joints, or preferably capped elbows; the writer has found that, wherever the sectional area of the pipe is not maintained constant, and has any space where eddying can occur, dust rapidly accumulates and chokes the pipe; to obviate this, the pipes should be provided at each bend with a cover as shown in the following sectional sketch, fig. 4.

Fig. 4.

Mr. Mathot, in his articles, considers a number of points not here referred to, and concludes with some interesting details relating to the proper manner of installing producer gas engines.

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Long-Wheel-Base Trucks.

My first words in reply to Mr. Acland must be to thank him for his very able criticism of my letter and my work, and his very kind remarks concerning my gear, and the attempts I have made to produce something that shall be far more satisfactory than the present tramcar trucks.

I must take this opportunity to express my thanks in return to the numerous tramway managers and officials who have shown such enterprise and courtesy in this connection.

It is difficult to explain in a few words how economy can be obtained with wheels rolling on nominally straight track when the axles are "never parallel," but I hope my meaning will be quite clear if, speaking only of straight track, I point out that relatively to the straight line of motion which the mass of a car tends to make, each rail is not straight, but really a series of slightly reversed curves. With parallel axles an enormous amount of skidding is inevitable, whereas by a non-parallel axle truck, which must be provided with an extremely delicate steering control, the wheels are to a greater extent rolled to follow the sinuous rail, and that is why the grinding slip is less.

I have much pleasure in giving the precise facts demanded by Mr. Acland. The distance over which the car had run when the wheels at the end not fitted with my suspension wore $\frac{5}{16}$ in. in diameter more than the other end, was 20,000 miles. In both cases the difference in diameter of the wheels about the same axle was less than $\frac{1}{32}$ in.

Mr. Acland makes a correct observation when he says that occasional differences in diameter of wheels on either axle may be as much as $\frac{3}{16}$ in. There is no accounting for anything that may happen, corrugation or anything else, so long as trucks are run which are built with the axles rigidly parallel.

The fact in this case that we were looking for the results we obtained, and that theoretically they are the results we should have obtained, is, I think Mr. Acland will agree, quite a different thing to obtaining some peculiar result, the cause of which puzzles everybody.

I notice on the West Ham Corporation Tramways they have recently added on one car having my suspension, a top-deck cover weighing about 25 cwt., which rather serves to illustrate the confidence that those who have tried my system have in it.

It may be noted that the figure of wear, $\frac{5}{16}$ in., given by me, which Mr. Acland comments upon, is not the ordinary figure of miles run per $\frac{1}{8}$th of radial wear, but is a comparative figure between one end of the car and the other, and judging by these figures, I think we might say that we could fit a Warner single-axle bogie to one end of any car, with any other form of truck at the other end, bogie or otherwise, and show at least half the wheel wear.

Mr. Acland will understand that I would like to answer him much more fully and completely did space permit, and in conclusion, I will again express my thanks to tramway officials, and also to the technical Press, for their kindness in giving publicity to my work on trucks.

J. Sutherland Warner.

London, S.W., *October 29th*, 1907.

I note in Mr. Conaty's letter of the 21st inst., that he fails to understand the grounds on which I base my statements. This being so, I have nothing further to say.

J. Sutherland Warner.

London, S.W., *October 29th*, 1907.

P.S.—Of course a careful and intelligent perusal of the specification will clear up the whole matter in the direction I have already indicated.

Prepayment Meters.

Viewed in the light of experience gained with prepayment meters, one is forced to believe that it will be some years before manufacturers will bring them to such satisfactory working order as to render them good investments, or admit of their use to the same extent as prepayment gas meters. Some of the gas companies collect 20 per cent. and many 10 per cent. of their revenue through prepayment meters.

Can you give any particulars of the extent to which prepayment meters are used in America, as one may look to the country that produced the cash register with some hope of success in this matter?

Call Again.

Electric Meters.

In examining the Board of Trade rules regarding the testing and permissible inaccuracy of electric meters, it is noted that "a meter will be considered accurate, if being intended for currents exceeding three amperes, but not exceeding 50 amperes, the error at one-tenth of its full load and above this point does not exceed $\pm$ 2½ per cent." Now it is well known that although the meter may be sent out with its points well within this limit, ageing of iron and brake magnets, dust, &c., will so alter it that at a couple of points or so in its range it will possibly exceed this figure, and it becomes a difficult matter in face of the rule to satisfy a consumer that in all probability the plus and minus errors will cancel out and things are O.K. Would it not therefore be better to ascertain his load factor and base any corrections which may have to be made on the error at the particular point of the curve where this lies? Perhaps the matter would bear ventilation.

K. P.

Snowdon Hydro-Electric Installation.

In your description of the Snowdon hydro-electric installation, you make what I take to be a reference to my connection with it in its earlier stage, but I gather from a gentleman recently returned from London that the work I actually carried out is not generally known. With your permission, therefore, I give the following particulars:—

When the matter was first brought to the notice of

Messrs. Harper Bros., they asked me to report on the water power and feasibility of the scheme generally. From frequent measurements, observations of the catchment area, and analysis of rainfall statistics, &c., I furnished reports in March, 1903, the basis of which appeared over the name of Sir Douglas Fox.

When it was decided to proceed with the work, I designed the pipe line, fixing the diameter thickness, methods of jointing, &c., and from a number of rough surveys chose the route actually adopted, as well as the position of the intake at the lake, these differing very considerably from the original Parliamentary plans.

I definitely fixed the site of the power house and tail race, and got out the main lines of the power house and plant. I specified the number and sizes of generating units, the periodicity and voltage of supply, and also recommended three-phase for working the railway.

I interviewed the various quarry owners to explain the technical details, and show how electric power could be applied economically to their existing machinery, and travelled most of the ground where the transmission lines have been erected, and specified the details of poles, cross-arms and insulators.

Last, but certainly not least, it was I who first introduced Messrs. Bruce Peebles to Messrs. Harper Bros., and suggested that they should be given the contract. That in itself was a good deal more than half the battle, as, with the help of Ganz & Co., the firm rose to the occasion, in a very creditable way to themselves.

As I got very little out of it in a financial sense, I am the more anxious that the professional work which I did during some two years should be recognised, hence this letter. I know that my backing the scheme in the face of considerable adverse criticism was of great assistance to the financial promoters.

E. Kilburn Scott.

University of Sydney,
September 16th, 1907.

Electric Tramcar Brakes.

Permit me to preface my remarks on the above subject with a few words of apology for dragging out a topic which discussion has worn rather threadbare.

I am of opinion that a fair percentage of the accidents, which from time to time give the travelling public a sense of insecurity, might be averted by knowledge on the part of motormen of a brake which, though existent on nearly all series-parallel controllers, is by no means so widely known as it should be! I now speak more especially with regard to some of our smaller provincial systems on which the training of drivers is not carried out under the supervision of a qualified official, but is left largely to the driver of the particular car on which the novice happens to be practising.

I refer to the "trick emergency," a brake applied by reversing the controller (relatively to the direction in which the car is travelling) on to the parallel notches (not necessarily the highest).

A thorough knowledge of this extra braking facility would, I believe, prevent many deplorable accidents, as it will be seen that a bad controller connection, which may render the rheostatic or emergency brake (according to the type of controller) inoperative, may not come into use on this reverse position. In order to show the utility of this brake, let us take an instance which is of common occurrence on every line :—

A car ascending a gradient loses her power owing to the failure of current on that particular section or to her trolley leaving the wire. The motorman brings his controller to the "off" position and applies his hand brake simultaneously, and may quite possibly, if the car be heavily laden or the gradient a severe one, let her slip back a little. This slipping back has led, and I fear will lead, to serious mishaps.

If under these conditions the car controller were left in exactly the same position in which it was when the current failed (*i.e.*, the parallel running notch), the car would, in all probability, drift back slowly, coming to an almost complete stop every few feet, and even if the rails were greasy, her speed would be greatly retarded on running back on the sand she would have used in climbing.

One thing is obvious, this entirely automatic brake would considerably minimise that rapid backward acceleration which has repeatedly lost the best men their control over their cars, especially in cases where the hand brake has failed at the critical moment. If the section were dead and the feeder was replaced while a car was braking herself in this manner, one of three devices would open the circuit, either the fuse or automatic switch (if so fitted) on the car, or the feeder automatic, surely a matter of small moment compared with the risk involved by a runaway car.

A little consideration will show that this supplement to the regulation electric brake may be used with the car proceeding in either direction.

I would also like to say a few words *re* the recently-raised question of the conductor manipulating the rear brakes in case of a car running back. This practice seems undesirable for the following reasons :—

(*a*) In some types of brake rigging the respective ends of the car oppose one another so far as the hand brake is concerned.

(*b*) The conductor, not always a qualified driver as well, would probably apply the brake in such a manner as to cause "skidding," and so make matters worse.

(*c*) The wheels should be comparatively free from the mechanical brake so as to give the electric brake a chance to catch, as rheostatic, emergency and "trick" brakes are all dependent for their action upon the rotation of the wheels.

I would suggest in such an emergency that the conductor should *actuate the sanding gear* merely (a pedal or other form of control being kept on each platform, and not as on some lines changed from end to end in company with the driving handles), all other operations being performed by the motorman. The conductor should only touch the brake on the motorman's instructions, such instruction being conveyed by a "standard emergency signal." This would leave the driver quite free of any misapplication of zeal on his mate's part, and would, I am convinced, give him a far better chance of averting a catastrophe.

I have made these few suggestions in the hope that they may meet the eyes of those tramway officials who have up to the present underestimated the importance and emergency utility of the brake of which I have written. In conclusion, I must plead guilty of repetition, inasmuch as several passages in this letter are identical with those contained in a letter which you did me the honour of publishing in your issue of July 13th, 1906.

S. C.

Your comments on the Halifax affair were, I take it, not intended to be instructive, but to show what, in your opinion, was the most likely sequence of events which took place on that occasion. Whether you were correct or not, must, unfortunately, remain a matter of opinion. I infer, however, from your article, that, had not the trolley left the wire, the motorman might have saved the situation by reversing his motors. This same opinion has been expressed on other occasions during inquiries as to the cause of other accidents, and conductors have been reprimanded for "pulling down the trolley, thus depriving the motorman of the power to reverse his motors," yet the accidents were proved to be due to the hand brake being applied too much, causing the wheels to "skid." I venture to say that if the hand brake is sufficiently powerful to "skid" the wheels, there is little to be gained by releasing it and *attempting* to reverse the motors, even if the latter can be successfully accomplished; and since the clearing up of every little point in connection with these lamentable accidents will tend to prevent their recurring, I suggest that this would be an interesting subject for discussion in your columns.

A. Johnston.

Swansea, *November 4th*, 1907.

[We intended rather to show what *might* happen than what had actually happened, and for this reason we specially stated that we took a "purely hypothetical case"; we wished to avoid casting any unjust reflection on the driver in the Halifax accident.—Eds. E.R.]

The Electrical Trade and Co-operation.

The article in your issue of September 13th under the heading of "The Electrical Trade—A Co-operative Proposal," has stirred my feelings as a Britisher, and I desire to express my personal convictions on a subject of which I feel myself qualified to speak.

By way of introduction, it should be explained that my firm are importers of English electrical machinery and accessories in this market on a fairly large scale, and as such the opinions expressed are based upon actual experience of the comparison between English, German and American electrical productions in a foreign mart, and, perhaps I may be permitted to add, the views are taken through rather differently coloured spectacles to those of the British manufacturer.

In the first place, then, it cannot be denied that the electrical industry in the United Kingdom is in an unsatisfactory condition, as, I believe, is generally admitted by those who have had an opportunity of comparing the amount of work turned out by American and German factories with that of the English factories, and the question at issue is the cause of this backwardness and the remedy. Now, I would have it understood that, in my opinion, article for article, the English productions are in no sense inferior to those of our foreign competitors, and I may even go so far as to say that very often they are superior, but the difficulty seems to be that, in many directions of this industry, the English manufacturer cannot hold his own. Now this inability to be in the swim is nowhere so apparent as in the case of telephones and telephone equipment, where the great bulk of the trade is in the hands of Continental factories. Indeed, so true is this that I believe myself correct in saying that the English makers cannot secure the lead on British soil; how much less, then, can they compete abroad? This is usually put down to the 'ower wages ruling on the Continent and the absence of protective tariffs in England, but how many of our manufacturers even think of looking for the cause in, first, the undoubted fact that in the initiatory stages of manufacture they look for too much profit; secondly, they refuse to sink capital in large productions and consequent large stocks; thirdly, the lack of businesslike propaganda; and lastly, and perhaps most important of all, their unwillingness to maintain technical and experimental staffs, whose duties should be confined to improvements and invention, which is such an important department in the factories of our competitors?

How many of our factories keep a "thinking man" whose energies are not diverted to executive channels?

From the article which I have already quoted, I gather that it is the idea of some of the manufacturers to arrange an "understanding" between themselves, which, of course, means increase of prices all round and the adoption of a still more conservative policy. Let me suggest that this method can never have the result so ardently aspired to, and that healthy competition is now, and always has been in every department of the world's commerce, the means of increased effort, progress and advancement. I should be very sorry to see my countrymen wasting their time and money in such a "co-operative proposal" (in other words, a cartel or trust), whilst the foreign competitor is busying himself in the prosecution of experiments and labours to the still greater discomfort of the Britishers.

Up then, countrymen, and reclaim that which by right is yours, by concentration of your individual forces, decrease your costs by greater productions and larger stocks, study your competitors' successes and from what they originate, make propaganda and leave those who want to be left behind to the arrangement and formation of their "co-operative proposal," whilst you are seeking new markets and regaining the old ones.

I may add from personal experience, my remarks are not only true of the telephone industry, but also of nearly every branch of the electrical trades.

Adelante.

Buenos Ayres,
October 9th, 1907.

PROCEEDINGS OF INSTITUTIONS.

Physical Society.

At the meeting held on October 25th, 1907, Prof. J. Perry, F.R.S., President, in the chair, a paper by Dr. J. A. Fleming, F.R.S., on "Magnetic Oscillators as Radiators in Wireless Telegraphy," was read by the author. An open or Hertzian oscillator is called an electric oscillator because the effects produced in space are due in part to the potential of the free charges at the ends. A closed-circuit oscillator is called a magnetic oscillator because the effects it produces are wholly due to current. Hertz showed that the energy radiated per period from an open oscillator could be expressed by the formula $E = 16\,\pi^4\,\phi^2/3\,\lambda^3$, where λ is the wave-length and ϕ the electric moment. The author has shown that a similar formula $E = 16\,\pi^4\,M^2/3\,\lambda^3$, where M is the magnetic moment, holds good for the closed-circuit oscillator. Assuming persistent or undamped oscillations to be used, these formulæ were transformed by the author into two others, viz.:—$W = 87 \times 10^{-20}\,l^2\,a^2\,N^2$ for the open oscillator, and $W = 4 \times 10^{-38}\,s^2\,a^2\,N^4$ for the closed oscillator, where a is the R.M.S. value of the current in the oscillator and N is the frequency. Hence the radiation from the open oscillator varies as the square of the frequency, and that from the closed one as the fourth power. The paper describes experiments made with flat square coils of various sizes used as magnetic oscillators in the quadrangle of University College, London. In one circuit undamped oscillations were set up by means of a Poulsen arc, and the induced oscillations created in the other circuit at a distance were detected and measured by means of the author's oscillation valve or glow-lamp detector. The distance separating the two circuits was varied from about 50 to 250 ft., and curves were obtained showing how the secondary current varied with the distance of the circuits apart and with their relative position. It was shown that the inductive effect was greatest when the flat coils were in a horizontal position and at a certain distance above the earth.

The law of variation with distance proved to be something between the inverse cube and the inverse square of the distance. It was then shown that increase in size of the coils had a very marked action in increasing the inductive effect, and also that for equal power the use of the spark method creating intermittent oscillations in the primary gave better effects than the use of the arc or undamped oscillations.

It was also shown that for the coils used the true radiation of energy was very small, and therefore that the distance effects obtained were almost entirely due to magnetic or Faradaic induction.

Suggestions were then made for increasing the efficacy of the ordinary inductive type of wireless telegraphy by the use of high frequency oscillations in the primary circuit, and a suitable detector such as the author's oscillation valve combined with a telephone as a receiver in the secondary circuit. Such a method would have a far greater reach than the ordinary low-frequency alternating-current inductive telegraphy and would not be open to the objection of disturbing commercial telephonic circuits.

Mr. A. Russell asked whether the author had been able to find a position for the secondary coil in which no current was induced in it. Possibly buried pipes or metallic conductors, iron girders in adjacent buildings or iron railings in the neighbourhood, might have had some influence in modifying the inductive effects between the coils.

Mr. Taylor said that the Post Office had tried arrangements similar to those described for magnetic space telegraphy, and had found that the closed-circuit method was inferior to that in which earth-connected vertical coils were used. The ratio between the received currents when using an earth-connected and a closed circuit was often as great as 80 to 1, and he thought the improvements in the closed-circuit method would have to be very great to make it equivalent to the earthed-circuit method.

A paper "On the Use of Variable Mutual Inductances" was read by Mr. A. Campbell. In connection with wireless telegraphy, the measurement of small inductances and capacities is of importance; one of the methods described has special reference to small self-inductances. Mutual inductances can be more easily dealt with than self-inductances, for the former (1) can be more accurately calculated from dimensions, (2) are less affected by change of frequency, and (3) when variable can be made to pass through zero value. A convenient form of variable mutual inductance consists of a continuously variable part and a series of steps. The first consists of two equal parallel coils with a third coil moving parallel to their planes round an axis eccentric to the fixed coils. The scale thus obtained is very open near zero (which is an advantage), and the graduation is done by experiment, a theoretical discussion being given in an appendix. The steps are obtained by means of another fixed coil of stranded wire, each strand giving an equal sub-division. The model shown had two ranges, from 0·01 up to 200 and 2,000 microhenries. A variable mutual inductance of this type has a number of applications. It is obviously convenient for calibrating ballistic galvanometers. By means of it mutual inductances of all values can be readily measured. By several methods it can be used to measure capacities, and the formulæ required are mostly very simple. Its most important application, however, appears to be to the measurement of small self-inductances, as follows:—Let the variable mutual inductance be called W. With a source of intermittent or alternating current and any convenient detector (vibration galvanometer, telephone, &c.) a bridge with corners A, B, C, D is formed, in which B D and D C are equal non-inductive arms, A B is the fixed secondary of W, and A C has resistance and self-inductance equal to those in A B. The detector is across B D, while the source is applied at D and also through the

primary of W connected to A. When W is set to zero reading a balance is obtained. An unknown small self-inductance N is now inserted in A C, and the balance restored by adding resistance in A B and adjusting the mutual inductance W. The reading of W when doubled gives directly the value of the unknown N. The method is really a differential one, and can also be used to give very accurate measurements of the difference between two nearly equal large self-inductances.

The discussion on Mr. Campbell's paper was postponed until the next meeting.

Earthing the Neutral in High-Tension Systems.*

AT the meeting of the American Institute of Electrical Engineers, held October 11th, the subject of the grounded neutral, with and without series resistance, in high-tension systems was treated at length in a paper by Mr. Paul M. Lincoln. Papers relating experiences with the grounded neutral were presented by Mr. George I. Rhodes and Mr. F. G. Clark. Abstracts of these three papers are given below.

Mr. Lincoln showed that the following advantageous results accompany the use of the grounded neutral: The electromotive force between a conductor and the ground remains fixed and constant. Abnormal static induction on neighbouring circuits is eliminated. Opportunity for using the ground as a working conductor is provided. It is possible to detect (and remove immediately if desired) a "ground" on any portion of the system. The condenser currents drawn from the several phases are rendered equal. Among the disadvantages were noted the following: One "ground" disables a part or the whole of the system. A proper "ground connection" is difficult to obtain.

Even where good engineering practice dictates a resistance in the neutral, the unavoidable resistance in the ground connection is not so valuable as it might be, because of its extreme variability. The difference of the seasons, as well as the drying-out action of any ground current that may flow, will cause large variations in ground-resistance. However, on high-potential systems the presence of even the maximum amount of resistance that is contingent upon good construction is rarely sufficient to cause trouble.

The object sought in "grounding" the neutral is to take care, not of normal conditions, but abnormal ones. It is the first thought of the operating engineer to maintain the service, and he therefore installs automatic circuit-breakers and other devices to protect the system in case an abnormal condition arises. The abnormal conditions that may arise are: (1) Short circuits; (2) Open circuits; and (3) "Grounds."

With the neutral connected direct to earth, a "ground" on any conductor means a short-circuit; the action of automatic circuit-breakers will then take place. The amount of current that will flow through such a short-circuit can be limited by inserting resistance, and practically the only object of resistance is to cause such a limitation of current.

The flow of excessive currents, such as would take place were there no resistance, is detrimental for several reasons. It throws an unnecessarily great strain upon the circuit-breakers which are called upon to interrupt the current. The large current-flow which takes place may cause a phase distortion and a drop in voltage, which may, in turn, be sufficient to cause synchronous apparatus on the line to drop out of step. Almost invariably an arc takes place at the point of "grounding" of conductors, and an excessive current will cause excessive destruction at this point. A dead short circuit on any system causes a heavy shock due to the tremendous currents, and a consequent tendency to distort the windings of any synchronous apparatus connected to the system.

All of these objections can be overcome to a greater or less degree by inserting resistance in the neutral. Increased neutral resistance, however, while it limits the current flow through a grounded conductor, and overcomes the above objections, can do so only by allowing an increase in the potential of the two good conductors "above ground" while the current exists. If the object in "grounding" is to prevent such an abnormal rise, the insertion tends to defeat that purpose. The choice of the proper resistance becomes a question of compromise between the disadvantages of going to either extreme. There seem to be good reasons for adopting a "grounding" resistance which will lie between the following limits—that large enough to prevent a severe shock to the system, or the voltage on the affected phase dropping to a point where the synchronous apparatus will drop out of step and that small enough to permit sufficient current to flow to trip the circuit-breaker.

In relating the experience of the Interboro Rapid Transit Co. with the grounded neutral, Mr. Rhodes stated that the chief circumstance which led to the grounding of the neutral of the high-tension system was the serious nature of cable burn-outs. The system was operated for about 3½ years without a grounded neutral, in which time about 160 miles of cable was operated for three years and 340 miles for one-half year. Since grounding the neutral, the system had been in operation for two years with about 340 miles of cable.

Previously to grounding the neutral, there were 12 distinct operating burn-outs, and since then there had been 16. It appeared from this fact that grounding the neutral had had no material effect on the number of burn-outs. This was as was expected.

Of the 12 burn-outs occurring previously to the grounding of the system, four shut down the power station; one other shut down two sub-stations, and four more shut down one sub-station. Of the other three which did not shut down the sub-station, two were isolated in time to prevent a short-circuit.

Of the 16 burn-outs that had occurred since grounding the neutral, not one had caused a shut-down of the power station; eight had shut down the sub-station fed by the cable, two had caused one other feeder to open, and six had caused no disturbance other than the opening of the switches of the feeder in trouble.

Previously to the grounding of the neutral the switches operated with explosive violence on the short circuiting of a cable, at times throwing oil and burning the contacts. Under present operating conditions, however, the switches always opened very quietly, so quietly in most cases that it was necessary to install a tell-tale to indicate when there had been abnormal current through the neutral rheostats.

Before grounding the neutral, in all burn-outs the cable was so badly injured that it was impossible to make any bridge test, and it was necessary to open a great many manholes before locating the trouble. Of the 16 burn-outs that had occurred since the grounding of the neutral, 14 of them were in such condition that the fault could be easily located by the Murray loop method.

In the above system the neutral point of only one of the generators is connected to earth, experience having shown that when the neutral points of several generators are simultaneously grounded very serious trouble is encountered from triple-frequency cross-currents in the neutral connections. Mr. Rhodes stated that probably something would be gained by increasing the resistance between the neutral and the earth connections. When the scheme was first contemplated it was planned to ground the neutral through 6 ohms, there being at that time only one power station. Now with two stations in parallel the effective grounding is through only 3 ohms, making the possible ground current twice that originally planned for. The use of the former resistance would have decreased the number of shutdowns of the sub-stations.

Mr. Clark stated that in a certain 11,000-volt system, a part of the circuits of which are aerial and a part underground, the neutral point of each generator is connected to a bus-bar through a fourth pole of the generator circuit breaker. The neutral bus-bar is connected to one end of a cast grid resistance suitably insulated. The other end of the resistance is connected to a ground plate located in earth kept moist with salt water. There is 6·7 ohms of resistance, or sufficient to allow 1,000 amperes in the neutral circuit in the event of a "ground." A current of 1,000 amperes will raise the temperature of the grid by approximately 1,000° F. in one minute. An ammeter on the switchboard indicates the amount of current in the neutral connection. A pilot lamp lights whenever 50 amperes or more flows through the resistance. This lamp remains lighted until an auxiliary circuit is opened, and has been instrumental in determining the number of short circuits that were also grounds.

During two years' operation there have been more than 70 short circuits. About 25 of these have caused sub-station interruptions, and six have been at locations near enough to the power station to cause power-station interruptions. About one-half of these short circuits showed a ground connection. There have been 10 "grounds," of which the neutral ground connection assisted in "clearing" eight. One held for four minutes and one for three minutes, both developing into two-wire short circuits. Although in case of a short circuit to earth the resistance of the ground path is sufficient to divert some current to neighbouring telephone lines, no serious telephone troubles have been encountered, and there have been no indications of trouble in telephone or telegraph lines caused by induced potential.

MR. PHILIP TORCHIO stated that the New York Edison Co. had in use about 200 miles of cables, operated at 6,000 volts and at 11,000 volts. The neutral point was not grounded, yet very few troubles had been encountered. He stated that the only real advantage in using a grounded neutral was the assistance received in disconnecting the damaged circuit. That is to say, the safety devices might be made to operate more positively when a grounded neutral was used than when such neutral was omitted. The New York Edison Co. had employed in connection with its underground system a relay device for disconnecting defective circuits, which was believed to be as reliable as any device employed with grounded systems. The device consists of a circular transformer core, which is placed over the cable. When the condenser currents in the three-conductor cables are in the normal three-phase relation, there is no resultant m.m.f. in the surrounding iron ring. When, however, there is a ground on the system, a certain amount of current which passes outward through one conductor of the cable does not return through the other conductors, but reaches the power house by some other route. Thus magnetism is produced in the surrounding iron ring. A coil wound on this ring is connected to a relay device which serves to open the circuit when the leakage current reaches a certain permissible maximum.

After further discussion, DR. C. P. STEINMETZ remarked that practically every opinion that had been stated by one speaker had been contradicted in equally strong terms by another speaker. This condition was attributable to the fact that each speaker discussed the problem from the view-point of his own system. What might be proper for one system operating under certain conditions would be improper for another system in which the conditions were different. Thus the solution of the problem would be entirely different for a system in which only cable work was used, and a system in which only overhead transmission lines were used. He stated that in general it was preferable not to ground the neutral of a system unless the conditions were such as to necessitate such grounding. In former years, the general plan was to keep all parts of the system thoroughly insulated from ground. At the present time, the general tendency was to connect everything to

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* *Electrical World.* Abstract.

ground that could be so connected. Dr. Steinmetz stated that it was usually good practice for the engineer, when in doubt as to whether to use a certain scheme, not to employ it if such scheme was in common use, because he unintentionally in most cases favoured that side which was the fad of the time.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Arc Lamp Lowering Gear.

In view of the experimental installation of street-spanning arc lamps which has lately been carried out in the City of London, it will be of interest to draw attention to some similarly suspended lamps in Devonshire Place, Eastbourne (see fig. 1), which have recently been converted to the lowering principle for Mr. Brydges, the borough electrical engineer, by the London Electric Firm, of Croydon. Previously the lamps were fixtures, and trimming with the tower wagon was resorted to.

The distance between the span wire poles is about 64 ft., and the winch is secured by wrought-iron straps to the outside of one of these, the wire rope running from it, over a guide pulley, to the contact and suspension device.

Fig. 2 shows a modification of this gear with special winch arranged for drawing the lamp with its gear horizontally along the suspension wire, and then down to the footpath, clear of the traffic in the centre of the road.

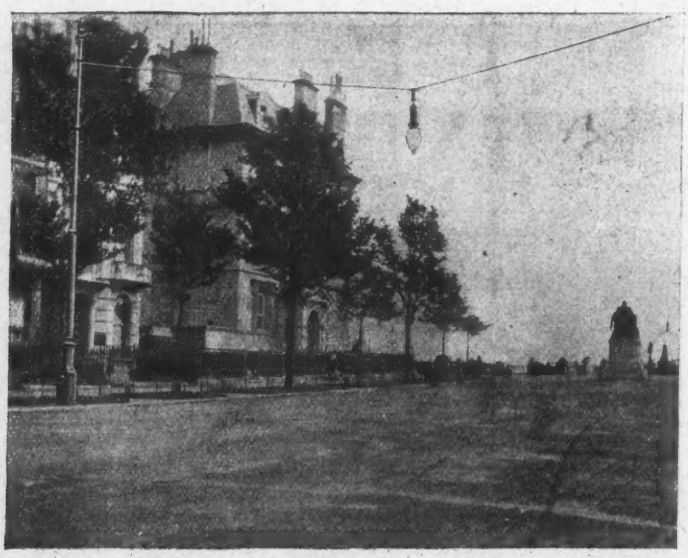

Fig. 1.—Arc Lamp Suspension, Eastbourne.

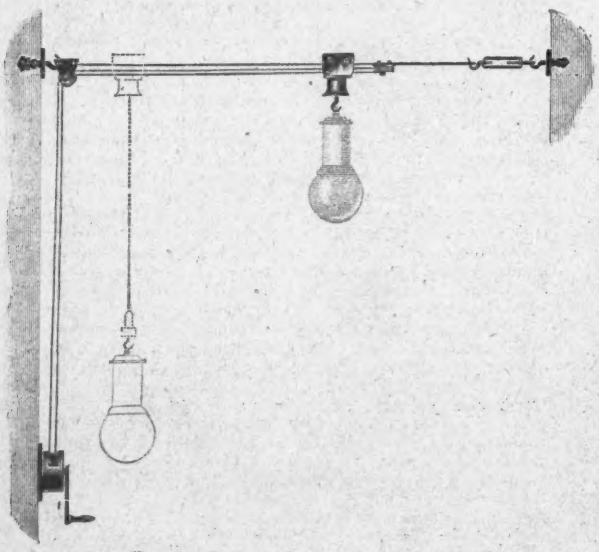

Fig. 2.—Special Lowering Gear.

The gear at Eastbourne is of the London Electric Firm's well-known positive action type, and the winch is of their self-sustaining type, both being patented.

A New Speed Indicator.

A neat form of indicator, based on a modification of a well-known method of speed measurement, has recently been put on the market by the Deutsche Tachometer Werke. In the form shown in figs. 3 and 4, it consists of a casing, in which the rubber-tired driving wheel m is carried in ball bearings. On the same spindle d as the

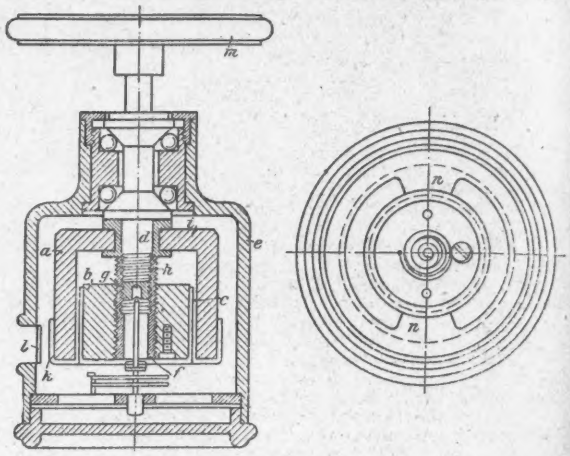

Fig. 3.—Section and End View.

Fig. 4.—Speed Indicator.

wheel, a bell-shaped permanent magnet a is mounted together with its soft-iron armature b. The magnet and armature are carried on non-magnetic bushes. In the annular air-gaps between the magnet poles and the soft-iron armature a light bell-shaped aluminium armature c is mounted. This aluminium armature is carried on centres, and its motion is controlled by two opposed spiral springs, which tend to keep it in the zero position. The aluminium drum c has an annular continuation k, on which a scale is marked, which can be observed through the window l. As soon as the magnet is set in rotation by applying the rubber-tired wheel to the object whose speed is to be measured, eddy currents are set up in the aluminium drum which produce a torque, and deflect the drum with its scale from the zero position. The scale can be calibrated to read peripheral speeds (for use in measuring cutting speeds in lathes, &c.), or in revolutions per minute. The rubber-tired wheel can, of course, also be replaced by a three-cornered or rubber-ended centre-piece if preferred. The torque exerted is considerable, since the aluminium drum is arranged to cut practically all the flux lines of the magnet, and iron losses are avoided by rotating the soft-iron armature with the magnet. The moving system is very light (2 grammes), so that it reaches a steady deflection almost instantaneously. The scale is a uniform one from zero upwards, so that equal accuracy in reading is attainable at all points.

The instrument is also made up in a somewhat more elaborate form for stationary use, with a pointer moving over a circular dial plate. Registering gear can be fitted, if desired.—*Elektrotechnische Zeitschrift.*

Nernst Projector Lamp.

This new patent automatic lamp has been designed to meet the requirements of lecturers, &c., and is specially suitable for lantern work, enlarging, bromide printing and cinematograph projection and stage work.

The patentees are the A.E.G. English Manufacturing Co., Ltd., 4, New Compton Street, Charing Cross Road, London, W.C., from whom full particulars can be obtained. They claim the following advantages:—Perfectly steady white light (about 1,500 c.p.); low current consumption (only four amperes); it is suitable for any

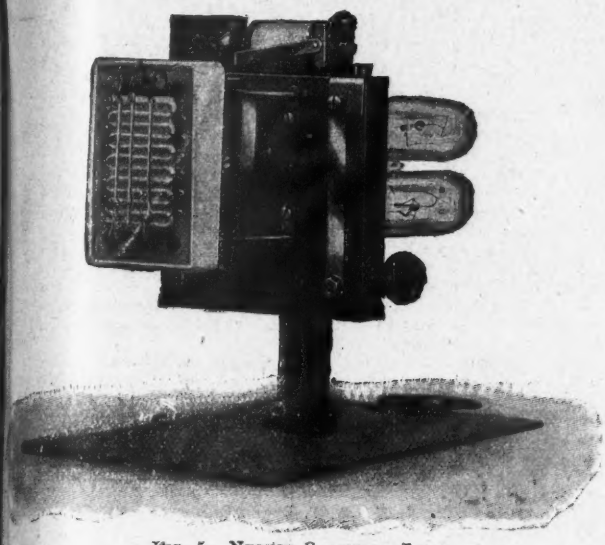

Fig. 5.—Nernst Projector Lamp.

voltage on direct or alternating current; it burns without attention (no carboning necessary); the candle power is always constant; exposures can be timed to a nicety; and it is portable (weighing only 3 lb.), there being no heavy cylinders or resistances to carry. The essential part is the burner, which has a heating coil and three filaments (one ampere each), which light automatically. Each filament under ordinary conditions would give 250 c.p., but by specially constructed resistances the current is increased and 500 c.p. is obtained. The filaments can be renewed at small cost.

Bennis Coal and Ash Handling at Hammersmith Electricity Works.

This installation was designed for handling small fuel at the rate of 20 tons per hour: the coal is carted into the works and tipped into a dumping bin arranged some distance from the boiler house. The dumping bin consists of a cast-iron cone-shaped tank for feeding the coal conveyor. To prevent large pieces of fuel or other material finding their way on to the conveyor, a grid has been fixed over the top of the dumping bin, suspended by means of four links and cranks, the motion or power for jigging the screen being given by hand by the attendant, by means of a lever arranged at one side of the dumping bin. From the dumping bin the fuel is elevated, conveyed and distributed through shoots into the overhead storage bunker, fig. 7.

The inclined portion of the conveyor is carried on a light lattice girder, supported in the centre by a braced leg. The vertical height through which the fuel is elevated by this means is about 40 ft. The horizontal or distributing portion of the conveyor runs the full length of the bunkers, and is provided with openings, shoots and cut-off slides, through which the fuel is delivered into any portion of the bunker. The slides are operated from a gangway above the bunker.

One of the advantages of this system of conveyor is the simplicity of its design, necessitating few actual working parts. It consists of a series of U-shaped links of 12-in. pitch, jointed together; the links are made of 2½ in. × ½ in. mild steel flats. The conveyor troughing is of special hard cast-iron, 12 in. wide × 8 in. deep.

The return, or idle portion, of the chain runs over cast-iron idlers with chilled peripheries, the trunnions of the idlers being turned and revolving in solid grease-lubricated bearings, which form part of the carriers or brackets, bolted to the conveyor troughing.

The conveyor chain is driven by a hexagonal drum and drags, through a substantial spur-wheel reduction gear, the first reduction being machine cut; power is supplied by a small 6 in. × 9 in. steam engine.

The ash or clinker is handled by a conveyor of the same type as that used for coal, excepting that it conveys and elevates the material in the reverse direction to the coal conveyor, that is, the gathering or horizontal portion of the conveyor is fixed in a small brick culvert under the boiler-house floor plates, the ashes or clinker being delivered on to the conveyor through cast-iron shoots, openings for which are provided in the floor plates. The clinker is elevated by the same chain conveyor to a height of 30 ft.

Conveying and elevating in this manner has hitherto involved difficulty in keeping the conveying side of the chain down on the bottom of the conveyor trough at the commencement of the inclined

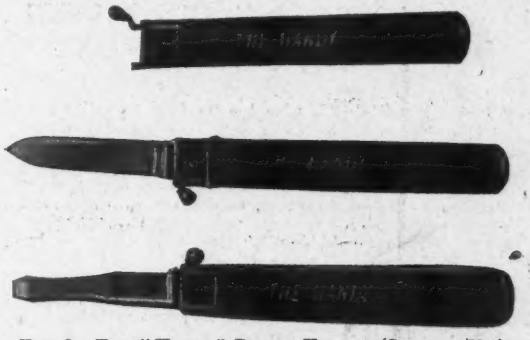

Fig. 6.—The "Handy" Pocket-Knife. (See page 764.)

portion. In the present case this has been very simply overcome by the fixing of three pairs of rollers at the commencement of the incline, which in no way interferes with the clinker or ashes. The clinker is delivered into a cast-iron cone-shaped tank, a simple form of rotary cut-off valve being provided on the bottom of this hopper.

The ash conveyor is driven in a similar manner to the coal conveyor, all the gearing and other parts being a duplicate, and power being supplied by a similar engine. Both the driving engines are of the well-known "Westminster" type, as manufactured by this firm.

The amount of power required to work these plants may, to some extent, be estimated from a consideration of the small size of the engines, both of which run at the comparatively slow speed of 100 r.p.m. To keep condensation down to a minimum (as

Fig. 7.—Coal-Handling Plant.

both engines are some distance away from the steam line), the steam for each plant is supplied to the engines through a ½-in. diameter pipe.

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Another point possibly worth notice from the aspect of economic maintenance, is the simplicity of the design and the strength of all the working parts.

Our illustration gives a fair idea of the "Bennis" system of elevating and conveying as applied to boiler houses.

"Handy" Pocket Knife.

The illustration on page 763 (fig. 6) shows an ingenious pocket knife for electrical wiremen, which has been brought out by Messrs. T. A. Mackereth & Co., of 81, Cockayne Place, Meersbrook, Sheffield. As will be seen, this implement combines pocket knife and screwdriver, the change being readily effected from one to the other.

SUNBEAM HIGH-VOLTAGE METALLIC FILAMENT LAMP DEVELOPMENTS.

When everybody electrical, with the possible exception of the alternating-current man—who has found his 100-volt circuits a blessing in disguise—is sighing for an economical high-voltage lamp with which to meet the competition which exists in the illuminating business to-day, it is perhaps opportune to draw attention to the efforts of the Sunbeam Lamp Co., of Gateshead, to provide this indispensable adjunct.

The company, as is known, has for some time past been busily experimenting with the metallic filament lamp, and if one may judge by results, is well on the way towards supplying a marketable product suitable for 220-240-volt circuits.

Through the courtesy of Mr. Grainger we were enabled to inspect several of these lamps which had been running satisfactorily for some time in his office; and for the benefit of our readers we record some interesting test figures obtained on ordinary lighting circuits. A batch of 26 lamps gave the following results on test:—

Hours of test	Zero	200	400	600
Number of lamps ...	26	26	26	24
Candle-power	24·9	25·5	24·8	24·2
Watts per candle-power	1·38	1·35	1·39	1·4

Another batch of eight lamps having an initial c.p. of 38, and taking initially 1·5 watts per c.p., gave after 800 hours' burning 34·9 c.p. with an expenditure of 1·6 watts per c.p.

A 45-c.p. 240-volt lamp, one of the earliest produced by the firm, taking initially 1·4 watts per c.p., gave after 1,125 hours' burning 38 c.p., with an expenditure of 1·6 watts per c.p.

These results, obtained as they are with lamps produced in their entirety by the Sunbeam Co., are very promising, and speak well for the enterprise of the firm, which, we understand, is carrying out further experiments with a view to obtaining a lamp which will burn satisfactorily on its side. Even in this direction lamps with an efficient life of 600 hours have been produced.

It is interesting to note that the company is now producing for the market, Leclanché jars and ships' glassware generally at its glass works.

LEGAL.

Manchester Tramcar Accident Claims.

The Manchester Corporation were the defendants in two cases at the Assizes last week, in both of which compensation for injuries was claimed by cyclists. The first was an action by Charles Edward Griffiths, who complained of having been run down by an electric car whilst cycling to business on July 13th. He received a shock, and the most serious—and possibly permanent—consequence of his injuries was that he had developed a painful stammer in speaking, which he had not before. Carelessness on the part of the car-driver was alleged. The plaintiff was approaching the point in Plymouth Grove where the line changes from a single to a double track; there was a large bogie car standing on the metals, and he was within ten or a dozen yards of this, riding on the same track, when, without warning, the driver put on power and ran into him. He was struck on the head by the brass rail, and his cycle was doubled up.

The defence was a total denial of negligence. The car-driver admitted that he saw the plaintiff coming towards him, but his conductor rang for him to proceed, and he did so, expecting the cyclist to turn aside and leave the track clear. This procedure the driver tried to justify. Although the plaintiff was only 12 yards from him, he considered it was his duty to start the car, having got the signal from his conductor.

Counsel for the plaintiff commented on this extraordinary view of a tramcar driver's duty, and in the end the jury awarded the plaintiff £110 damages.

William Henry Creer, the plaintiff in the second case, who was at the time a stoker in the employ of the Corporation, was knocked down by an electric car in Ashton Old Road, on the night of May 11th. He turned out of a side street, he said, and saw the car coming, but thought on account of its distance, he could clear the track easily. Such was the speed of the car, however, that its step caught his hind wheel, and he was thrown over. Falling with his right hand upon the tram rail, he had four of his fingers taken off.

There was a conflict of evidence as to the exact cause of the accident, but the jury believed the plaintiff's story, and awarded him £175.

Wednesbury Corporation *v.* British Accumulator Co.

In the King's Bench Division on Friday, November 1st, before Mr. Justice Phillimore and Mr. Justice Walton, the case of the Mayor and Corporation of Wednesbury *v.* The British Accumulator Co. was again mentioned. It came before the Court earlier in the week on the appeal of the defendants from an order of Mr. Justice A. T. Lawrence in Chambers reversing an order of Master Archibald which was favourable to the appellants. The question between the parties was whether under an agreement the defendant company was bound to go to arbitration with respect to a dispute as to its liability for the breakdown of electrical machinery. The appellants raised questions as to points of law upon the construction of the agreement, and submitted that these should be determined first, as their determination might render expensive proceedings before an eminent engineer unnecessary.

It was now stated by counsel that the parties had come to an agreement as to the course to be pursued. The defendants were prepared to accept service of writ, the action to be tried by a Judge alone sitting with an assessor, one expert on either side to be called, apart from witnesses called to speak of questions of fact; both parties to make every effort to expedite the hearing, and the costs of the present proceedings to be within the determination of their Lordships.

The order of Mr. Justice A. T. Lawrence was accordingly discharged upon the terms agreed, and their Lordships left the costs of this application within the discretion of the Judge of the trial.

Bellamy *v.* The Wakefield District Tramways, Ltd.

In the Chancery Division of the High Court on Friday last week, before Mr. Justice Joyce, Mr. Younger, K.C., who appeared on behalf of the plaintiff in this case, asked that it might stand over for a fortnight, in order that all differences might be composed.

His Lordship assented.

COMBINED GAS ENGINE AND TURBINE PLANT.

In the article on "Large Gas Engines" published in our issue of October 24th, p. 708, we mentioned that additional data had been received from Mr. Leonard Andrews, too late for insertion. These are given below:—

The curves reproduced in fig. 1 show the total running costs per unit, with capital charges, for load factors varying from 10 per cent.

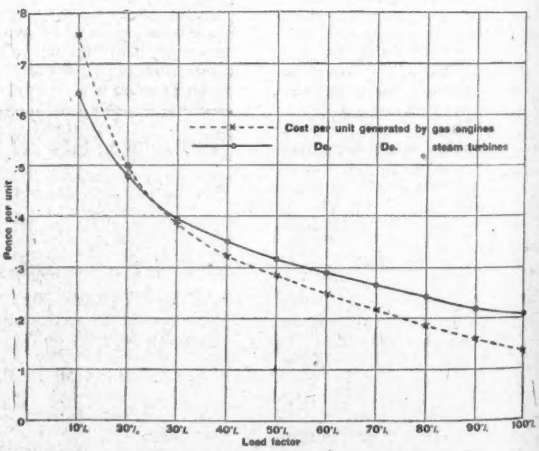


Fig. 1.—Comparative Costs of Generation with Gas Engines and Steam Turbines.

to 100 per cent. for a 16,000-kw. steam turbine plant and gas engine plant respectively.

Whilst no public supply undertaking can ever hope to attain a 100 per cent. load factor for the whole of the plant, it is possible in most cases to run a portion of the plant on a very high load factor. It is, in fact, common practice in steam-driven generating stations to run the most economical plant practically throughout the 24 hours

of each day, and to reserve the less economical portion of the plant for the peak load, and there appears to be no reason against this practice being extended to the combined use of steam and gas-driven generators.

If we take as an example the case of a public supply undertaking having a total plant capacity of 16,000 KW. and a maximum demand of 13,000 KW., it will be found that the daily variations of load will follow approximately the curve set out in fig. 2. It is assumed that the current generated is used for private and public lighting, traction and power.

The curve has been drawn to show the maximum load and the average daily duration of the loads of various values, with the approximate time of day at which the various demands would be likely to occur.

It is suggested that 25 per cent. of the total plant should be gas engine and by-product recovery plant, and that the remaining 75 per cent. should be steam turbine plant.

The average load on the gas-driven generators will then correspond to a 62 per cent. load factor, whereas the steam turbine

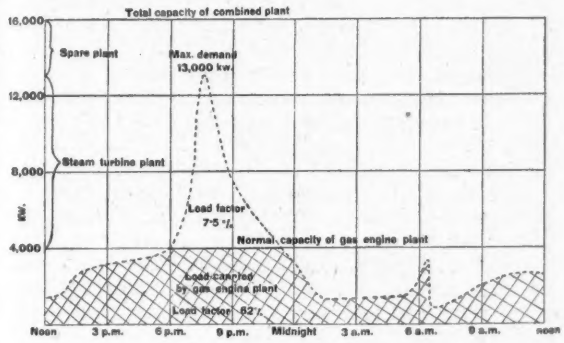


FIG. 2.—LOAD DIAGRAM.

plant will be running on a load factor of only 7·5 per cent., the combined average load factor being 24 per cent. of the maximum demand, or 19·5 per cent. of the plant installed.

The capital cost of this combined plant will be approximately as follows:—

Steam turbines and generators ...	... £72,000
Gas engines and generators ...	... 41,000
Boilers and auxiliaries	... 61,000
Gas producers	... 24,500
Buildings and foundations ...	... 24,000
Switchgear	... 5,250
Allowance for contingencies ...	... 11,387
	£239,137

The running cost of the combined plant on a 20 per cent. load factor (24 per cent. of maximum demand) will be, for an annual output of 27,620,000 KW.-hours, approximately as follows:—

Fuel for steam plant	... £5,300
Fuel for gas plant	... 6,100
Labour	... 6,500
Repairs	... 3,950
Oil, waste and stores	... 1,250
	£23,100
Interest and depreciation	... 24,148
	£47,248

= ·41d. per unit.

The cost of dealing with the above output by gas-driven generators alone would be £56,500 = ·49d. per unit, and by steam turbines alone would be £55,000 = ·48d. per unit.

It will be seen from the above that it is possible to effect very considerable economy by a judicious combination of gas engines and steam turbines.

ELECTRIC POWER ON THE WITWATERSRAND.*

THE advent of the Victoria Falls Power Co. inaugurates a new era in the production of electric power on the Witwatersrand, and it may therefore be interesting to consider a few typical instances of modern plants in recent operations as projected at the present time for supplying power to individual or groups of mines, exclusive of the Brakpan and Driehoek stations lately acquired by the Victoria Falls Power Co.

The largest of such stations is that erected in the year 1905 by the East Rand Proprietary Mines for supplying power to the four producing mines of the group, including the electric driving of the Angelo and Cason mills. The power plant consists of three 1,000-KW. Belliss-General Electric Co. steam alternators generating three-phase current at 3,000-3,300 volts. Steam is supplied from Marshall Heine boilers at a pressure of 180 lb. per sq. in. superheated 100° to 150° F. The condensing plant is of the surface type, with Edwards air pumps and centrifugal circulating pumps, the condensing water being cooled by a system of spray coolers. The lay out of this station is on the most modern lines, the possibility of future extensions embracing larger units having been fully provided for in the boiler and engine room arrangements.

The constant load provided by the Angelo and Cason mills, together with other surface plant, has resulted in a load factor of over 90 per cent. being regularly maintained—a figure which has seldom, if ever, been excelled in any power plant. Under these circumstances the works costs on an output of nearly 17 million units per annum come out at ·6d. per unit generated, without including interest and depreciation; allowing 12 per cent. for the latter, the figure becomes ·85d.

The Rand Water Board have recently started up at their new power plant at Zwartkopjes pumping station, three 360-KW. Belliss-Westinghouse three-phase steam generators, 3,300 volts, twenty-five periods, in connection with their new pumping scheme for the supply of the Witwatersrand area.

These plants supply current for operating pump motors at wells within a radius of 4 miles from the pumping station. They are supplied with steam at a pressure of 175 lb. per sq. in. superheated to 500° F. Two condensing plants are installed, the circulating water is obtained by means of a by-pass from the rising mains, at a temperature of 72° F., which is, of course, exceptionally favourable for the maintenance of high vacua. Under the above conditions a guarantee was given of 18·5 lb. of steam per KW.-hour on full-load, which figure has been obtained on test.

Six plants of the above make and size have also been lately installed on the properties of the Rand Mines, Ltd., the alternators in this case being arranged for 2,000 volts, 50 periods.

The Langlaagte Estates and Gold Mining Co. are at present installing an extensive scheme of electric driving in connection with their tube mills; in this case the power will be derived from two 500-KW. Belliss-A.E.G. direct-current generators, the latter being one of the few examples of the use of direct-current for power purposes on these fields.

At the Village Main Reef Gold Mining Co. two 750-KW. plants have been running for over a year. These are Allen-A.E.G. three-phase, 50-period machines, and are used largely in connection with an electric hoist which has been recently installed.

In addition to the above there is probably a greater variety of turbine plants in operation on the Witwatersrand than in any other district in the world.

Parsons turbines are running at the Porges Randfontein Gold Mining Co., the Ginsberg Gold Mining Co., and the Braamfontein Estates Co.; Curtis turbines at the Robinson Deep Gold Mining Co. and the Witwatersand Deep Gold Mining Co.; Rateau at the Crown Reef Gold Mining Co.; Riedler-Stumpf at the Witwatersrand Gold Mining Co.; the above plants varying in size from 200 to 500 KW.

The Randfontein Estates Gold Mining Co. have recently ordered two 1,000-KW. Parsons turbo-alternators for their new power station on the Randfontein Central Gold Mining Co. These plants will generate at 6,600 volts, 50 cycles, and will be used, in the first instance, for operating tube mills and other surface plant on the producing mines. They will be supplied with steam at a pressure of 160 lb. per sq. in. superheated to 500° F. The condensing plant will be of the surface type, with air and circulating pumps driven by electric motor; the Parsons vacuum augmentor will also be fitted. It is expected that this station will eventually be the largest on the Rand outside those of the Victoria Falls Power Co.

* *Mining Journal.*

Supply of Electrical Fittings by Local Authorities.

—The opponents of municipal trading will welcome the latest addition to the "Model Bill," as amended by the House of Lords for Session 1908. The clause which confers upon local authorities the power to provide and deal in electrical fittings has been amended by the insertion of the following proviso:—

"Provided as follows:—

"(*a*) It shall not be lawful for the Corporation to expend money (except through a contractor) upon the provision of such fittings or of labour and materials required for the fixing, repairing or removal thereof upon or from the premises of their consumers or prospective consumers;

"(*b*) The Corporation shall so adjust the charges to be made by them for any such fittings or for the fixing, repairing or removal thereof as to meet any expenditure by them under the powers of this section in connection therewith (including interest upon moneys borrowed for those purposes and all sums applied to sinking fund for repayment of moneys so borrowed);

"(*c*) Every sum charged by the Corporation to a consumer in respect of the provision of such fittings or the fixing, repairing, or removal thereof shall be separately stated on every demand note delivered by the Corporation to the consumer.

"(*d*) The total sums expended and received by the Corporation in connection with the purposes in this section mentioned in each year (including interest and sinking fund) shall be separately shown in the published accounts of the electricity undertaking of the Corporation for that year."

It is a stringent provision and one which will doubtless be insisted upon by the authorities of the Upper House.

REVIEWS.

Manual of Wireless Telegraphy. By A. F. Collins. London: Chapman & Hall, Ltd. Price 6s. 6d.

This little work is intended to instruct and inform the wireless telegraph operator, or him who desires to become an operator. The plea advanced for its production is that though there are numerous works on the subject, there are none written specially for the operator. To this end the author gives a popular elementary explanation of the general principles, more or less detailed descriptions of various systems, with more or less useful diagrams of connections, numerous photographic reproductions and a certain amount of commercial information relative to the organisation of wireless telegraphy of a kind intended to be useful to the operator. The purpose of the work is commendable, but the execution is, in some respects, deplorable. The latter remark applies especially to the attempts made to convey an idea of the principles underlying a large part of the work. The author is particularly unhappy in his analogies, most of which are unsound and altogether unconvincing, even to an open-minded operator. For instance, in referring to the swinging pendulums to illustrate unison of resonant circuits, the diagram shows two pendulums coupled by a cord near their free extremities—an arrangement which when put into practice by the inquiring operator or student will show anything but the principles of resonance as claimed by the author. In this connection also, the not unusual, but wholly incorrect, statement is made that a difference in the *weights* of the pendulums will put them out of unison. The term "phase" is also applied incorrectly. One more blunder only, of a wholly inexcusable kind, will be referred to relative to the author's definitions of close-coupled and loose-coupled oscillation systems. A close-coupled system is, it is said, one in which there is direct electrical connection between the two resonant circuits, whilst a loose-coupled system is one in which one circuit acts inductively on the other. Statements of this kind, examples of which might be multiplied, are not calculated to show that the author is qualified to write on the subject. Much of the descriptive matter is feeble in the extreme, and unsatisfying even to an operator who only desires superficial information. In the later chapters there is also some information of a novel kind, and numerous misprints. Thus we learn from the catalogue of wireless stations that Malta and Gibraltar are in the British Isles!

Die Telegraphie ohne Draht. By Augusto Righi and Bernhard Dessau. Brunswick: Friedrich Vieweg and Son. Price 15 Mark.

This is a comprehensive treatise of some 665 closely printed pages, and 312 illustrations. Allied matters, as well as wireless telegraphy proper, receive considerable attention. It embraces, in the first few chapters, such subjects as the electric field and its scientific treatment, the magnetic field, electric discharges in gases, the theory of electrons and the constitution of matter, all from the pen of Prof. Righi himself with entirely up-to-date but non-mathematical treatment. References to original papers and articles are freely given throughout the work, and a bibliography in this connection is furnished at the end of each chapter. In the portion dealing with wireless telegraphy proper, a complete history of the development is given together with full particulars of practically all known systems.

As a descriptive work it is, perhaps, as complete as any other yet published. From the fact that the recent developments in wireless telephony by the aid of the Poulsen arc receive a share of attention, it will be gathered that the authors have endeavoured to bring the work as far as possible up to date. They have adopted a non-committal attitude in respect of the credit attaching to Marconi for his early work in the field. This is interesting in view of the pronounced feeling, amounting almost to animosity, which there is reason to believe was exhibited by Prof. Righi in common with several other well-known scientists in the early days of wireless telegraphy. As a German treatise the work would, of course, be incomplete without some reference to the International Berlin Conference for the regulation of wireless telegraphy, and it is no exception to the rule, full abstracts from the Protocol being given.

La Télégraphie sans fil et la Télémécanique. By E. Monier. Paris: H. Dunod and E. Pinat. 1906. Price 2 fr.

This is a popular exposition of the principles of wireless telegraphy compressed into a small volume of 120 pages, with a preface by Dr. E. Branly. The ground covered embraces the elementary phenomena of electric currents, the elementary principles of the production and detection of electric waves, brief descriptions of the principal pieces of apparatus used in wireless telegraphy, and an explanation of the so-called "Télémécanique" of M. Branly, by means of which it is claimed that a number of separate machines or pieces of mechanism can be controlled from a distance, each or any of them being operated at will. Very similar contrivances have been described by others, so that the invention would not appear to be quite so novel as might be gathered from a perusal of this little book. The work is freely interspersed with eulogies of M. Branly and his connection with the inception of wireless telegraphy.

Since the first issue this pamphlet has been enlarged to 142 pages, the additions being mainly in the descriptive portion of the work, and some of the more recent receiving appliances for wireless telegraphy being alluded to. The work contains no new features calling for special comment. It is issued with uncut pages, and is hardly a creditable production in the matter of binding.

Elements of Electric Traction. By L. W. Gant. London: Harper & Brothers. 1907. Price 5s. net.

This book is something more than a handbook for motormen, and something less than a treatise on electric traction. It is the betwixt and between which has been wanted since motormen ceased to be promoted labourers and became a class to themselves, and the author has done his work well.

The book is based on a series of lectures which Mr. Gant has given for the past two years before a class of motormen and others at the Leeds Institute Technical School, and there can be no surer method of turning out an educational book than to live with one's readers, and to ascertain by the touchstone of experience just what it is that they ought to learn, wish to learn, and are fit to learn.

It may be urged in criticism of the book that much of it is as old as the hills, and has reappeared in the elementary part of every text-book that has been written. Here, for instance, is all the old stuff about Ohm's law, with the usual string of examples; there, again, are the classic illustrations of a simple dynamo, and so on. But how are these things to be avoided? For elementary minds elementary matter must be provided, and the whole course must be between two covers, for motormen and the like cannot afford or will not buy a library.

The most carping critic will admit that Mr. Gant has made his preliminary chapters interesting, which is a long step on the road to education, but a doubt crossed our mind when skimming the book, whether it could be read without assistance. The earnest motorman, burning the midnight oil, has no Mr. Gant at hand with a ready explanation of hard words or perplexing passages, and we feel sure that he would be wanted.

The remedy lies in the hands of those officials throughout the country who are responsible for training drivers and conductors. Here are illuminating lectures ready-made, needing only the will and a sound personal knowledge of the subject to enable substitutes for Mr. Gant to spring up in every tramway, however small.

Unfortunately, there are many tramway managers who discourage the technical education of their men, generally on the ground that a little knowledge is a dangerous thing, and that a man is not a better driver for having some further acquaintance with the reasons for the motors turning than that the "juice" goes through them.

The adage quoted above is true enough, but we protest

that the aim of the manager should be to raise his men out of the state of little knowledge in which they certainly are under his conservative rule, unless he is bold enough to say that they are totally ignorant, and keep on raising them until they have emerged from the half light of little knowledge, into the clearness of mastery of their subject. We assert, moreover, that every motorman is a better driver for knowing intimately, not after the parrot fashion of the majority, what is happening when he does the things that he is doing all day.

Mr. Gant's book will be useful to many outside and above the rank of motorman, and we know of tramway engineers who would be the better of a few meals from its pages.

BUSINESS NOTES.

A New Turbo-Generator Business in Germany.—It is announced that the Berlin Machine Construction Co. (formerly Schwartzkopff), and the firm of I. A. Maffei, of Munich, have jointly formed a new company under the title of the Maffei-Schwartzkopff Works, for the construction of steam turbines and incidental electrical generators, and other high-speed machine sets. The share capital of the company is £150,000, of which one-half has been subscribed by each of the founders, and works are to be built in Berlin for the purpose. The type of turbine which the company will work, is that brought out by Melms & Pfenninger, of Munich. The company will take over the electro-technical department of the Berlin Machine Construction Co., which will continue to manufacture the generators until the new works are built, whilst the firm of I. A. Maffei, of Munich, will produce the turbines during the same initial period.

Royce Electric Crane Contracts.—Messrs. Royce, Ltd., of Trafford Park, have received from Messrs. Richardson and Cruddas, engineers, of Bombay, an order for four overhead electrically-driven cranes, which, it is stated, will be the first of their kind on the West Coast of India; also the following orders:—

Messrs. E. H. Hunter & Co., of London, for four electrically-driven cranes for use in the additions which the Osaka Engineering Co., of Japan, are making to their already extensive engineering works.

Three electrically-driven cranes for Messrs. Kerr, Stuart & Co., engineers, of Stoke, Staffordshire.

Messrs. Galloways, Ltd., for an electrically-driven crane for their new boiler works at Ardwick.

Messrs. the Churchill Machine Tool Co., Ltd., of Pendleton, for an electrically-driven crane for use in their new extension.

Messrs. Selig, Sonnenthal & Co., of London and Coventry, for cranes for their new works.

A repeat order for an electrically-driven crane from Messrs. Jos. Buckton and Co., Ltd., of Leeds.

Water Softeners.—Messrs. Lassen & Hjort, of London, E.C., have secured an order for one of their water-softening plants capable of dealing with 15,000 gallons of water per hour, from the Wemyss Coal Co., Ltd., East Wemyss, Fife.

Japanese Steel Works.—The Lancashire Dynamo and Motor Co. have recently secured a contract for the equipment of the generating station for the Kabushika Kwaisha Mihon Seiko Sho. This contract was placed by Baron Yamanouchi, of the Imperial Japanese Navy, and the value is considerably over £30,000. The equipment comprises three 1,000-kw. generating sets, consisting of Belliss triple-expansion engines and Lancashire compound interpole generators with slip-rings and static balancers for giving a three-wire supply at 440 volts across the outers. The contract also includes pipework, condensers, floor plating, switchboards, cables, &c., for a complete power station equipment. Nearly 300 motors of the Lancashire Dynamo Co.'s make, most of which are of large size for variable speed of 3-1, will be used for driving machine tools, gun-boring lathes, cranes, &c.

Catalogues and Lists.—The Sunbeam Lamp Co., Ltd., Gateshead-on-Tyne.—We have received a hanging bannerette such as this company is issuing to the trade as a means of assisting them in bringing the "Sunbeam" lamps before the notice of the general public. A trade circular has also been issued drawing attention to the various lines of manufactures produced by the company, including, of course in addition to Sunbeam lamps, electric light fittings, instruments, switches, motor-starting gear, cables, conduits, arc lamps, dry batteries, insulators, radiators, carbons and glassware, of all of which they keep a stock. A complete range of samples is on view for inspection at their Newcastle depôt and showroom, 21, Northumberland Street. Any member of the electrical trade can have one of the above-mentioned bannerettes on application.

The Sun Electrical Co., Ltd., 118-120, Charing Cross Road, W.C.—New catalogue (Section B, 52 pages) containing well illustrated particulars and prices of a variety of types of electric bells, indicators, relays, pushes, wooden blocks, window contacts, batteries, small measuring instruments, wiremen's tools, &c.

Messrs. Thomas R. Martin & Co., Ltd., 77, High Bridge, Newcastle.—Several pamphlets describing "Tinol," the metalline soldering paste combining both solder and flux, which is already known to most of our readers. It is claimed to be suitable for heavy or light work, and in the latter class it has been satisfactorily used by electrical instrument makers, jewellers and similar trades. One of the circulars contains a report by Dr. M. Corsepius, of Cologne, on a duration test made with resistance wires soldered with this material. Another leaflet gives copies of a number of testimonials received from electrical firms in Germany.

Messrs. Willans & Robinson, Ltd., Victoria Works, Rugby.—Advance copy of the firm's catalogue of surface condensing plant. This is an imposing production, containing a number of admirably-executed half-tone pictures of their surface-condensing plants, Edwards' patent air pumps, electrically-driven circulating pumps, &c. The views include two of condensing plants that have been supplied to the Glasgow Corporation, with 1,500 and 3,000-kw. turbines. Particulars are briefly stated indicating the information required for estimating purposes. The descriptive matter relates more particularly to ordinary surface condensers, but the company also hold the rights for the manufacture of the "Contraflo" condenser, in addition to that on the "Vacuum Augmenter" principle, of both of which sectional drawings are given. They are thus able to combine these two principles in one plant, and claim to have obtained results that have not been approached in other directions. A list of surface condensing plants supplied and on order at September 1st, 1907, accompanies the catalogue, and shows how important this department of the firm's works has become since it was started about two years ago.

Aktiebolaget Bronskol, Stockholm.—A list of stock sizes of brushes, which covers a wide range. It is claimed that Bronskols are particularly satisfactory for tramway work. The W quality is used for alternating, and the G quality for direct current. Samples and details can be had by applying to Mr. Archibald Campbell, 27, Chancery Lane, W.C., their British agent.

Messrs. Electromotors, Ltd., Openshaw, Manchester.—We have received from this enterprising company an effective wall showcard and calendar, of large size. In the general design a number of neat illustrations appear of the firm's electric motor equipments, as supplied for works and factories. The calendar consists of monthly slips covering from the current month up to April, 1909.

The Lahmeyer Electrical Co., Ltd., 109—111, New Oxford Street, London, W.C.—Two convenient-size pamphlet price lists, with sectional finger index at top, covering the following:—No. 1c (20 pages), large continuous current dynamos and motors; No. 11f (28 pages) three-phase alternators. Speeds, dimensions, freight charges, and other like useful information is given.

Mr. Albert C. Hands, 30 and 32, Snow Hill, London, E.C.—12-page catalogue illustrating a number of designs of the "A.C.H." luminous-type electric radiators. Prices are quoted.

Dowsing Radiant Heat Co., Ltd., 24, Budge Row, London, E.C.—Hanging showcard illustrating a number of the firm's luminous electric radiators. Prices and a few particulars of each are given. A couple of pictures at the top are intended to impress the reader with the convenience and comfort of electric heating in the home. Between these pictures is a note showing that, at 1d. per unit, the cost of electric heating used in the four-lamp radiators is 1d. per hour, and in the two-lamp sizes, ½d. per hour.

Dissolutions and Liquidations. — Furnace Fire Brick Co., Ltd.—A meeting of this company is to be held at Scott Street, Keighley, on December 3rd, to hear an account of the winding up from the liquidator.

English Electric Carbon Co., Ltd.—A meeting is to be held at 41, Regent Street, Wrexham, on December 5th, to hear an account of the winding up from the liquidator, Mr. J. S. Wynne.

Petroleum Engine Co., Ltd.—A meeting is to be held at Moorgate Place, E.C., on December 4th, to hear an account of the winding up from the liquidator, Mr. T. E. Shuttleworth.

Totnes Electric Lighting Co., Ltd.—Creditors must send particulars of their debts, &c., to the solicitors for the liquidators (Simpson & Bowen, 2, Princes Street, Bank, E.C.) by December 14th.

Chelmsford Electric Lighting Co., Ltd.—Creditors must send particulars of debts, &c., to Messrs. Simpson & Bowen, as above, by December 14th.

Electricity Supply to a Village.—We have received the following letter from Mr. Jackson:—"On September 20th I wrote a reply to 'Water Power' *re* cheapening the electricity supply to a village. This has induced others besides 'Water Power' to make inquiries, and letters from abroad are causing some inconvenience to the Post Office as I did not give my full postal address. My system is reducing the cost of a supply previously existing by more than 50 per cent., and is worth inquiring about. Will correspondents in future kindly address their inquiries to Joseph Jackson, Wenlock, Hindes Road, Harrow, Middlesex?"

"Oriflamme" Arcs.—Messrs. Oliver Arc Lamp, Ltd., have recently received the following orders for their "Oriflamme" lamps:—31 for the City of London experimental lighting at present being carried out; Croydon Corporation (extension, 100 lamps); Dundee Corporation (extension, 10 lamps); Maidstone Corporation (extension, 21 lamps); Portsmouth Corporation (50 lamps)—all for street lighting. Newport Corporation (for shop lighting), and Messrs. Dick, Kerr & Co., Ltd. (40 lamps) for the Calcutta Electric Tramways.

Electrolytic Copper in Russia.—It is announced from St. Petersburg that a company has just been formed in that city under the title of the Elektrolyse for the creation of works on behalf of a group of Russian firms who work up copper. At present the requirements in the matter of electrolytic copper

amount to approximately 8,000 tons per annum, but only a portion of this quantity is produced in the country, the remainder being imported. It is now proposed to establish works at Moscow for the output of the electrolytic product in order to satisfy the inland demand.

Book Notices.—*Glasgow and W. of Scotland Technical College; Annual Report.* Glasgow: The College.—During the session 1906-7 there were 5,762 day and evening students, the former alone numbering 544; out of the total 156 were graduates of various universities. The second section of the new buildings has been begun, and will, it is hoped, be ready for the session 1908-9. The current expenditure for the year ended July 31st, 1907, was £33,514. The Report contains much interesting information regarding the work of the session, and is embellished with excellent illustrations of the new laboratories, &c.

"Steam and Exhaust Pipes." By R. McGregor. London: The *Electrical Times*. 1907. Price 1s. 6d. net.

"Science Abstracts," Sections A and B. Vol. 10, part 10. London: E. & F. N. Spon. Price 1s. 6d. each.

"Popular Fallacies." By A. S. E. Ackermann, B.Sc.Eng. London: Cassell & Co. 1907. Price 6s.

"Diagrams of Connections for Storage Batteries." London: Tudor Accumulator Co., Ltd.

"Week-End and Holiday A.B.C." November. London: 119, Pall Mall, S.W. Price 6d. net.

International Electrical Exhibition at Marseilles, 1908.—It has been decided to hold an exhibition of the applications of electricity at Marseilles next year on a large scale; it will be open from April 19th to October 31st. It is claimed that the South of France offers an important field for the development of electrical industries, especially in Marseilles and the neighbouring ports, in the local mines and quarries, whence bauxite is obtained in large quantities, and in agriculture. Electrically-driven pumps for irrigation should form a special feature. Particulars can be obtained from the Commissariat Général, 52, Boulevard Louis-Salvator, Marseilles; a number of pamphlets are also available at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, E.C.

Supplies' Radiators.—Messrs. Supplies, Ltd., of 9, Parr Street, Liverpool, the design of whose electric radiators is already quite familiar to our readers, have unfortunately been unable to get their radiator meter ready for this season, though there was a large inquiry for their radiators with the meter. They have now resolved to unload some of their stock during the present season without the meter, but they are fully expecting to have the latter working satisfactorily in the near future. We understand that the radiators have been specially designed and made extra strong, and that the fittings, such as lampholders and contacts, are all specially made; there is a special spring contact to ensure good contact with the lamps.

Insulating Paints.—The Antacidine Co., of Southall, Middlesex, ask us to state that their insulating paints and varnishes are entirely free from linseed oil or its compounds. They also supply "Antacidine" paint for terminals and batteries, which is claimed to be an effective resister of sulphuric acid.

Factory Premises.—Messrs. Leopold Farmer and Sons, of 46, Gresham Street, E.C., are offering certain riverside warehouse and factory premises for occupation. Some particulars will be found among our advertisements to-day.

Bankruptcy Proceedings. — Henry Wainwright, electrical engineer, Barnsley, Yorks.—Receiving order made October 29th on debtor's petition.

Henry Wainwright, electrical engineer, Farrar Street, Barnsley.—The first meeting of creditors, and the public examination, are to take place at Barnsley on November 15th.

K. C. Moran, electrical engineer and contractor, Walsall, late of Coventry.—A first and final dividend of 1s. 4d. in the £ is payable on November 11th, at the Official Receiver's Office at Wolverhampton.

Trade Announcements. — The amalgamation is announced of the engineering firms, Applebys, Ltd., and The Temperley Transporter Co. These firms are well known as manufacturers of cranes and transporting machinery of every description, specialising in shipyard, dock, and harbour equipments, steel-works, coal-handling, and contractors' plant. The amalgamated firms will trade under the title of Applebys, Ltd., with offices at 58, Victoria Street, Westminster, and works at Glasgow and Leicester.

The paragraph published last week concerning the Perfecta Seamless Tube and Conduit Co., Ltd., has given the impression that the company are no longer represented by agents anywhere. This is, however, not the case. What we might perhaps have made a little clearer was that the opening of the offices and stores at Victoria Street, S.W., means that the company is no longer represented by agents *in London*. The note did not in any way relate to provincial agencies already existing.

Instrument Factory Extended.—Mr. Robt. W. Paul has just completed the erection of a new wing to his electrical instrument factory at New Southgate, N. In the basement has been installed a Stockport gas engine and suction plant, replacing two gas engines previously running on town gas. On the ground floor is a 20-kw. Brush dynamo for lighting, and several small motor-generators supplying direct and alternating currents for testing purposes, the extension being required principally for the manufacture of standardising instruments for alternating-current measurements. The contract for the wiring (218 lights) has been placed with Messrs. Roger Dawson, Ltd., under the supervision of Messrs. Handcock & Dykes, consulting engineers.

Reduction of Capital.—Triumph Stoker, Ltd., and Reduced.—A petition for confirming a resolution reducing the capital from £6,000 to £3,000 is to be heard on November 19th, before Mr. Justice Swinfen Eady.

LIGHTING and POWER NOTES.

Buenos Ayres.—The output of the German Electric Light Co., of Buenos Ayres, for lighting, power and traction for the first eight months of 1907 was 12,094,063, 5 804,393 and 29,537,035 units respectively, which compares with 9,653,224, 4,284,251 and 7,153,320 units respectively in the corresponding period of 1906.

Cleckheaton.—The U.D.C. has decided to substitute electricity for gas for public lighting at Whitcliffe.

Clyde Valley.—The Clyde Valley Electric Power Co. is developing its power supply on the Clyde; the following works, among others, are now being supplied with energy:—Messrs. Yarrow's Shipbuilding Yard, Scotstoun; Messrs. Napier & Miller's Shipyard, Old Kilpatrick; Clyde Trust Workshops, Renfrew; Coventry Ordnance Works, Scotstoun; Messrs. Scott & Sons' Shipyard, Bowling; Messrs. Lobnitz & Co.'s Shipyard, Renfrew; and Messrs. Beardmore's Shipbuilding Yard, Dalmuir.

Colwyn Bay.—A L.G.B. inquiry was held on October 31st into the application of the U.D.C. for a loan of £3,000 for E L. purposes; the chief item being £1,155 for a cooling tower, and the balance for cable extensions. The Inspector (Mr. F. H. Tulloch) commented on the fact that some of the work had been put in hand, and said that the L.G.B. objected to such a practice. There was no opposition.

Continental Notes.—Paris.—On November 1st the new reduced tariff for electricity came into force all over Paris. The six sections into which the city was divided, are now amalgamated under one scale for the hectowatt and its accessories. For private use as light the hectowatt-hour will henceforth only be charged seven centimes, or about three farthings, until January, 1914, after which a further reduction will be made to a halfpenny. For industrial purposes a proportional diminution on existing contracts will also come into force. For "accessory" expenses, such as deposits, hire of meters, &c., a reduction of from 40 to 60 per cent. will be made. According to the convention passed between the new Amalgamated Society and the City of Paris, the former has to lay down about four miles of transmissions and construct two generating plants of 25,000 kw. each.

Devonport.—Excellent progress is being made with the work of installing the electric light in the War Office magazines and other property at Bull Point, Devonport. The main electric lighting cables have been laid, and the laying of the submains is well advanced. The arc light standards have been fixed in position in readiness to receive the circuit leads, and the smaller standards for lighting the passages and railways are also practically complete. The system of lighting the magazines and danger buildings is similar to that used in the Naval Ordnance Depôt, viz., by incandescent lamps fixed on brackets outside the windows and entrances of the buildings, the circuits being laid outside the walls in stout galvanised piping, thus ensuring absolute immunity from fire. Special attention is being given to the lighting of the jetty from which ammunition is received or embarked, two powerful arc lamps being fixed in suitable positions. The buildings will be supplied from the same plant as that which feeds the Naval Ordnance circuits, ample provision having been made for this when the station was designed.

Durham.—The B. of G. has requested the County of Durham Electrical Distribution Co., Ltd., to furnish a scheme, giving the estimated cost of lighting the workhouse by electricity.

Greenock. — The new electrical generating plant erected by the Corporation in Dellingburn Street was opened on October 30th. by Treasurer Brown, convener of the Electricity Committee. Some time ago the municipal authorities decided to build a refuse destructor, and as the existing electricity works in Hunter Place has been producing its full output for several years, it was further resolved that the heat available from the burning of the refuse should be utilised in raising steam for the production of electricity. Although the destructor is not yet completed, the latter part of the scheme has now been inaugurated. The total cost of the destructor and electric power station is estimated at about £41,700.

Kingston-on-Thames.—The T.C. has decided to open a showroom for electric fittings, &c.

Leyton.—The Local Government Board has sanctioned the borrowing of the following amounts in connection with the electricity undertaking:—£2,770, excess expenditure, extension of electric lighting station, for 25 years; £400, machine tools, for 10 years; £2,000, extension of mains, for 20 years; £500, services, for

15 years; £500, meters, for 5 years. It has been decided to convert a number of the existing street arc lamps into flame arc lamps. Owing to the possibility of the flame lamps being worked four in series, and the units of the series being arranged to alternate, 24 is the maximum number of lamps which can be converted, and the cost will be about £13 per lamp, or £312.

Llanelly.—The U.D.C. has decided to negotiate with the Llanelly and District E.L. and Traction Co. for the purchase of the E.L. Order.

London.—Paddington.—At the meeting of the B.C. on Tuesday, the Works Committee again brought up an adjourned report recommending that arrangements should be made with the Metropolitan Electric Supply Co. for lighting a portion of Harrow Road at an estimated cost of £264 per year on a 10 years' agreement. In addition, there would be an initial cost of £10 each, with regard to the conversion of certain lamp-posts. The Finance Committee in a report on the matter pointed out that the adoption of the recommendation would open up the question of electric light in the streets for the whole of the borough. Certain communications from the Gas Co. and the Electric Lighting Co. had been received on the subject, proposing modifications, and the report was referred back.

City.—On Friday last the new street arc lighting, carried out by the City of London and Charing Cross Companies jointly, was brought into use. The lamps are suspended over the roadway with a view to obviating the use of standards.

Stepney.—The B.C. is making arrangements, by applying to the L.C.C., for permission to borrow the requisite sum to provide the equipment of the new generating station at Blyth's Wharf. The borough electrical engineer estimates that a sum of £10,250 will be required to meet the cost of further mains extensions. It is also proposed to borrow two sums of £10,000 each on account of sanctions already given by the L.C.C. to the raising of loans of £37,480 for provision of plant, and £10,000 for extension of mains.

New South Wales.—The Tamworth Municipality has recently put into service a new electrical plant with a capacity of 5,500 8-c.p. lamps. Messrs. Noyes Bros. were the contractors for the work.

Portadown (Co. Armagh).—At the monthly meeting of the T.C., on the 4th inst., the lighting of the town was discussed at considerable length. Mr. H. V. Pegg, the representative of the Belfast and North-East of Ireland Power Co., placed before the Council the details of an electric lighting scheme. His company, he said, had decided to erect the first station in Ireland at Portadown at a cost between £60,000 and £100,000, and from there it would supply other towns. The station would be completed in some 10 months' time. He suggested that the Council should adopt a scheme, and apply for a provisional order. Finally, the Council decided to expend £50 in obtaining professional information and advice. No matter what action the Council may take, the company referred to is going on with its scheme.

South Africa.—Power Supply in the Transvaal.—A Johannesburg correspondent of a German newspaper, after referring to the purchase by the Victoria Falls Electric Power Co. of the undertakings of the Rand Central Electric Co. on the far east of the Rand and of the Rand General Electric Co. at Germiston, states that the principal object of the new company must naturally be the establishment of a main station as central as possible. As the necessary space for an extension of the Rand general station is not available, it is proposed to utilise the land about the Simmer Pass for the erection of the chief station. This site is about 1½ miles directly to the south of Germiston, and the small lake which exists there will provide the water needed for the boilers. The Rand Central Electric station has a capacity of 3,000 kw., and this is to be increased to 9,000 kw. by the installation of two new turbine sets each of 3,000 kw. The machines are being furnished by the Allgemeine Elektrizitäts Gesellschaft, and are to be erected so that they can be eventually removed to Simmer Pass. The output of the Rand General Electric station remains at 3,000 kw. as hitherto. An understanding has been arrived at with the African-European Investment Co., which owns the coal mines of Vereeniging on the Vaal River, for the purpose of establishing a second power station on that company's property as soon as the requirements of the Rand exceed a definite amount. The correspondent adds that the only power station not included in the general amalgamation is that which the East Rand Proprietary recently built for the supply of its own mines.

Pretoria.—The electric power station at the Military Cantonments was destroyed by fire last month. Damage was done to the buildings and plant to the amount of £7,000, which is understood not to be covered by insurance. The building was only erected about 12 months ago.

South Australia.—In the House of Assembly, Mr. Verran moved for the construction by the Government of an electric lighting and power plant for the Peninsula mining districts, at a cost of £60,000, to supply light and power to Moonta, Wallaroo, and Kadina, and also to work tramways in those towns. The population to be served was, he said, over 20,000, and the towns named were very poorly lighted. The debate was adjourned. —*Australasian Hardware and Machinery.*

Surbiton.—A L.G.B. inquiry was held on October 29th, relative to the application of the U.D.C. for a loan of £20,000 for E.L. purposes, viz., £1,684 for extension of buildings; £2,121 for engine, dynamo, switchboard and accessories; £1,730 for a new boiler; £3,550 for services and meters; £2,900 for mains; and £2,602 15s. 2d. in respect of money already spent, the balance being for costs and contingencies. The inspector desired information as to the excess expenditure, and as to the contingencies, and the inquiry was adjourned until November 15th to enable these particulars to be supplied.

Tynemouth.—The Corporation electricity department is issuing a 40-page booklet on electric lighting, which contains much good advice to would-be consumers, and is suitably illustrated.

Victoria.—Melbourne.—The electric lighting business of the City Council continues to expand. For the six months ended July last there was an increase of 529,075 units sold, as compared with the corresponding period of the previous year. The revenue was £5,985 higher and the profit increased by £1,453.

Warrington.—The Electrical Committee has again considered the question of applying for a prov. order to supply Stockton Heath and other outlying districts, and has decided not to proceed with the matter.

West Africa.—An electric scheme is proposed for the lighting of Sekondi, on the Gold Coast.

West Australia.—An enlarged electrical plant was recently opened at Claremont by the Premier (Hon. W. J. Moore). Messrs. Noyes Bros. supplied the additional plant.

West Ham.—The Corporation electricity department has just secured a contract with the Wholesale Co-operative Society to supply their flour mills and their new soap factory at Silvertown with electrical power for all purposes. The contract is based on an annual consumption of 5,500,000 units.

Willesden.—The U.D.C. some time ago applied to the L.G.B., asking for sanction to a loan for sites for a future generating station and sub-stations in Denzil Road and Leicester Road. The Board has, however, refused to sanction any loan in respect of the sites, upon the ground that the Council has no present need of a generating or a sub-station, and there is no certainty that the same will ever be required.

TRAMWAY and RAILWAY NOTES.

Belfast.—At the bi-monthly meeting of the Harbour Commissioners on the 5th inst. (Mr. Robert Thompson, J.P., presiding), the following resolution of the Works Committee was adopted:—"Recommended that, in pursuance of the terms of the agreement between the Corporation and the Commissioners of May 14th last, the work of constructing the electric tramway along Queen's Quay, Sydenham Road and Queen's Road be proceeded with, in accordance with the specifications and plans approved by the city surveyor, city electrical engineer and the harbour engineer now submitted, at an estimated cost of £19,100, and that advertisements be issued for tenders for the work." The new line will open up the Sydenham suburb, and make Queen's Island easy of access. At present there is no tramway nearer than half a mile to the famous shipbuilding centre.

Blackburn.—The Main Roads and Bridges Committee of the Lancashire County Council has had under consideration the application to the Board of Trade of the Blackburn, Whalley and Padiham Light Railways for a further extension of time for 18 months within which to construct the electric system. The promoters, the Committee declares, have already had six years in which to construct the railways, and have not even raised their capital, much less have they commenced the construction of the works. The Committee has decided to ask the Board of Trade to give effect to its assurance of August, 1906, that further extension of time be not granted unless the construction of the railways is well advanced by the end of the year's extension then granted.

The half-yearly report of the Corporation tramways, issued on November 1st, reveals a record profit of £3,515. The income totalled £32,628, from 5,951,512 passengers, advertising firms, &c. The income was equivalent to 13·88d. per car-mile run, and the expenditure to 7·96d. per car-mile. Traffic expenses amounted to £6,876, general expenses to £1,440, cost of energy £5,907, and general repairs, &c., £4,513.

Bury.—A big scheme of extension is projected in connection with the Corporation tramways system, and the suggestions were brought to the notice of the Tramways Committee and the manager of the tramways (Mr. Wm. Clough) by a deputation from the Bury Tradesmen's Association on October 31st. The schemes submitted were the extension of the Limefield section through Shuttleworth and Edenfield; an extension of the Jericho section to Simpson Clough and on to Haywood, coupling up with the Bury and Rochdale section there; an extension of the Stokes section (Radcliffe) to Little Lever; and a proposal to lay tramways to Holcombe Brook, Ramsbottom, and on to Edenfield, where they would join the tramways from Limefield. The deputation was favourably received, and the Chairman promised to lay the schemes before the Tramways Committee; the deputation is hopeful that at least the Stokes extension, which is the most pressing, will be carried out.

Continental Notes.—ITALY.—La Società per la Tramvia Elettrica Padova-Pontevigodarzere is the name of a new company which has just been formed in Padua to construct an electric tramway between the towns named.

SPAIN.—A concession has been recently granted for the construction and working of an electric tramway in the town of Vallencia.

Dundee.—The question of the standard rate of wages which arose in connection with the construction of car-bodies for the Corporation, has now been definitely settled. It arose through the Society of Operative Coachmakers directly, and through the medium of the local Trades Council, pressing upon the Tramways Committee that the Standing Orders were being violated in respect that the standard rate of wages was not paid for the construction of the car bodies. The Brush Electrical Engineering Co., Loughborough, to which it was proposed to allocate the contract, and against which the accusation of underpaying was levelled, was represented at a recent meeting of the Committee, and took up the position that its rates for piecework were standard. The Committee, after hearing parties, saw no cause to interfere with the allocation of the contract.

Halifax.—Last week another car got out of control on the Sowerby Bridge route. In this case the car was travelling down hill, when presumably the power went off and the car began to gather speed. Happily the three men (who have charge under present arrangements) succeeded in stopping the car near the scene of the late accident.

Ilford.—The U.D.C. has deferred for the present the promotion of the Parliamentary Bill seeking powers to extend the electric tramways along Cranbrook Road. The object is, if possible, to secure tramways on the surface-contact system, offers having been made to carry out the scheme at the cost estimated for the overhead system.

London.—METROPOLITAN RAILWAY CO.—This company is experimenting with a new automatic signalling system on its line between Notting Hill and Praed Street. It is stated that provision is made for cutting off the power automatically in the event of a signal failing to act.

The company has now taken over the entire working of the Inner Circle, the District trains having been withdrawn. It is intended shortly to inaugurate a five minutes' regular service for the whole circle, and almost immediately a five minutes' service from South Kensington to Aldgate.

WEST HAMPSTEAD COLLISION.—The inquest on the bodies of the victims of the recent collision was opened on October 30th, certain evidence, including that of the motorman, being taken. The inquest was adjourned until Friday, November 20th, when Major Pringle will be invited to attend.

An experimental express theatre train having proved satisfactory between Holborn, King's Cross, Holloway and Finsbury Park, on the Great Northern, Piccadilly and Brompton Tube line, a similar train will be run regularly.

The Central London Railway is stated to be considering the advisability of introducing 1d. fares for short distances; the matter has been postponed owing to representations from competing interests.

The South-Eastern and Chatham Railway is, we understand, experimenting with an electric track signalling arrangement between Norwood Junction and Beckenham, in which the signals are visually reproduced in the cab of the engine.

L.C.C.—The Highways Committee has decided to recommend its original scheme of tramways to connect with the Crystal Palace, at a cost of £73,123. The alternative schemes would cost £291,713, £203,910, £140,000, or £295,150.

After being postponed on two occasions, the Council at Tuesday's meeting arrived at a decision in regard to the proposed tramways from Hammersmith Broadway *viâ* Brook Green Road, Shepherd's Bush Road, Wood Lane and Scrubs Lane to Harlesden. The Highways Committee estimated that the total cost of track-work, overhead electrical equipment, cables and ducts, rolling stock, switchgear, and a portion of the Hammersmith car-shed would amount to £107,630. As rails and cars had already been passed in previous votes, the Committee asked the Council to approve an estimate of £69,300. After some opposition had been made to the proposal on the ground that the projected line would not be remunerative, the recommendation of the Committee was carried.

PADDINGTON.—An arrangement has been made, at the instance of the Works Committee, whereby the Metropolitan Electric Tramways, Ltd., has agreed to remove the disused tramlines from Shirland Road and Chippenham Road, on condition that they are allowed to take a horse-car across the carriage-way in Chippenham Road once every three months in order to comply with the provisions of the Tramway Act.

MEDICAL EXAMINATION OF L.C.C. CAR-DRIVERS.—At the meeting of the L.C.C. on Tuesday, the Highways Committee presented a report on the medical examination of the motor-men. The report stated that the examination was suspended to allow of a consideration of the representations made by the men, although all fresh candidates for employment were examined before being engaged. After the summer recess the Committee went very fully into the matter, and on October 3rd received a deputation of the London district representative of the Amalgamated Association of Tramway Workers and certain of the tramway employés. It was pointed out to the deputation that instances had occurred of sudden indisposition of car-drivers, which occurrences were liable to lead to serious consequences, and that the course taken by the Council in the matter was adopted to ensure the safety of the public. At the same time the deputation was informed that while the Council must insist on some examination, so as to ascertain whether men in charge of electric cars were medically fit for the duty required of them, substantial consideration would be shown to men already in the Council's service as drivers. With this object in view, it was agreed that in the case of such men the examination should be of a modified character, which would, however, be a guarantee to the public against danger from the collapse of men while driving cars, and the Committee discussed with the deputation the lines which they thought such modified examination should take. The men were further informed that the case of any man whom the medical examiner considered to be unfit for employment as a motor-man would receive careful consideration, and that an endeavour would be made to find other employment for him at a wage, if possible, equivalent to that which he was then receiving. The proposals placed before the deputation were communicated to the district representative of the Association in a letter dated October 4th. No communication had been received in reply, and the Committee now proposed to resume the examination of the drivers in the Council's employ on the modified lines in question.

New Zealand.—The Takapuna Tramways and Ferry Co., Ltd., is being formed in Auckland, with a capital of £100,000, to construct and run a tramway between O'Neill's Point and Lake Takapuna under an option granted by the Waitemata County Council. According to the option granted on December 19th, 1906, the service was to commence within five years, and the term of concession is fixed at 60 years, and thereafter for successive periods of 10 years, until the local authorities elect to purchase.

TELEGRAPH and TELEPHONE NOTES.

Bahamas.—The Colonial Report for 1906 states that the revenue of the telegraph department was £1,258, as against £1,520 in 1905, the expenditure being £552 and £558 respectively for the same periods; 2,836 messages passed over the Nassau-Florida cable, of which 312 were to and from Great Britain, and 2,524 to and from other countries. During the year the telephone exchange in Nassau was completed, and has worked so successfully that it is now about to be extended from the original one-mile to a three-mile limit.

Wireless Telegraphy.—It is variously stated that the Clifden-Glace Bay Marconi system transmits at the rate of 10 and 20 words a minute. Taking five letters to the word, this means at most 100 letters per minute, each letter averaging, say, three signals or 300 signals per minute in all. As all the receiving is oral, this is practically the limit attainable—even on landlines, 25 words a minute is regarded as the maximum with the sounder. In view of these facts it is interesting to note that Mr. Edison, an old telegraph operator, has expressed the opinion that "in his sober judgment" Mr. Marconi, within 10 years, ought easily to be able to transmit 1,000 words a minute. We would not quote this remarkable statement were it not recorded in so reliable and highly esteemed a journal as the *Electrical World*. The maximum speed attainable on land with the Wheatstone automatic apparatus is about 600 words a minute, and the average speed between London and Manchester is about 350 words per minute. It is impossible to set a limit to the possible future developments in any branch of science, and it is true that the Pollak-Virag system of telegraphy with photographic recorders has attained still higher speeds—using two wires and an earth return—but to make such a forecast as that imputed to Mr. Edison is about as wise as to set a time limit to the establishment of communication with Mars.

A decree of the Minister of Public Works of France authorises the establishment at Saintes-Maries-de-la-Mer (Bouches du Rhône) of a wireless telegraph station for the purpose of communicating with ships at sea, and with other similar stations in France, Corsica, Algeria, Tunis, Monaco and Valle Andane. Private messages will be accepted.—*Journal Télégraphique.*

According to the *Elektrotechnik und Maschinenbau*, the actual number of wireless telegraph stations established is 254, of which 88 are claimed by the United States; Great Britain and Ireland, 43; Italy, 18; Germany, 13; Russia and Holland, 8; France and Turkey, 6; Argentine Republic, Brazil, Canada, China and Hawaii, 5; Denmark and Spain, 4; Sweden, 3; Gibraltar, Austria, Roumania, Mexico, Panama, Japan, Andaman Islands, Egypt, Morocco and Mozambique, 2; and Costa Rica, Montenegro, Portugal, Chile, Malta, Belgium and Norway, 1 each.

The Australian Government intends establishing regular wireless communication between Papua and Australia. During experiments on the high seas the battleship *Challenger*, notwithstanding a violent storm, remained in constant communication up to a distance of 1,300 nautical miles with the admiral's ship at Sydney.

Wireless Telephony.—The wireless telephones which have been on trial on the batteships *Virginia* and *Louisiana*, of the U.S.A. Atlantic Fleet, have been given the formal endorsement of the Navy Department by the purchase of 27 sets of instruments. The cost of this equipment, apart from the expense of its installation, will be more than $35,000. The apparatus will be supplied by the Radio-Telephone Co., being made under patents granted to Dr. Lee De Forest.

(*Continued on page 775.*)

THE UTILISATION OF WATER-POWER FOR INDUSTRIAL PURPOSES IN CENTRAL ITALY.

Hardly a generation ago the Abruzzi was one of the most primitive and least industrial corners of Central Italy, and no one could have guessed that there was a brilliant manufacturing future before any portion of that very unget-at-able region. It was still one of the remaining happy hunting grounds for the picturesque relics of the Papal *régime*, the brigands, who eked out a far from prosperous existence in the midst of the wild mountains and dales of the most extensive and elevated region of the Apennines. Now the not over-abundant population is among the most law-abiding of all Italy, and its material prosperity is improving almost as rapidly as in the industrial regions of Northern Italy. Every village along the valley of the Pescara, which is the main drainage channel of the Abruzzi, and, indeed, all the way along the railway from Tivoli through the district of the ancient lake of Fucino right to the Adriatic at Castellamare, now possesses its own electric lighting plant and generates its own electricity.

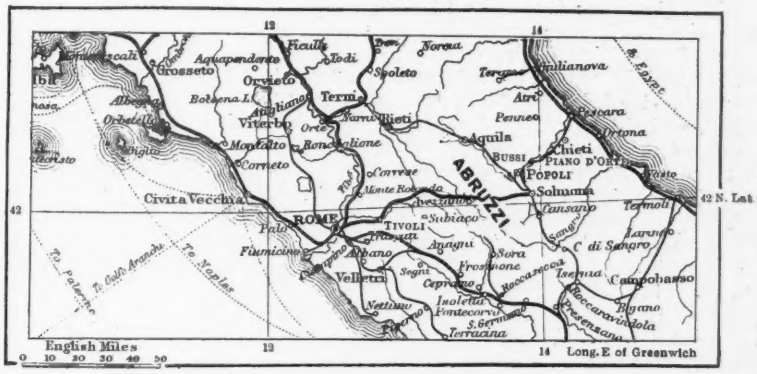


Fig. 1.—Map of Central Italy.

The secret of all this progress lies in the fact that the whole district possesses abundant water power. On the Mediterranean side the falls at Terni and Tivoli are too well known to need description—while on the Adriatic side the water, without being concentrated in any natural falls of similar importance, flows even more abundantly along the narrow valleys in streams presenting an endless series of rapids, which can readily be replaced by artificial falls without serious expense. The reason for this abundant supply of water is supplied by the fact that in this portion of the Apennines the mountains rise in two cases at least to close upon 10,000 ft., and that the snow lingers on a majority of the summits well into the hottest part of the summer.

The valley of the Pescara, on the Adriatic side, has so far furnished the water-power for the most important industrial undertakings which have as yet been planned and carried out in the Abruzzi, and there are ample natural resources for many more of a like character both in that valley and in its tributaries.

There are three factories at work in the neighbourhood of Bussi and Terre dei Passari—one producing aluminium and its derivatives, another the chemical products used in a variety of industries, and each employing over 1,000 hands—while the third, at Piano d'Orte, is devoted to the manufacture of chemical substances and fertilisers used in agriculture, and employs some 500 hands. The latter works, belonging to the Italian company for the manufacture of nitrogenous and other products, are in the process of considerable extension at the present time, and will before long also employ some 1,000 hands.

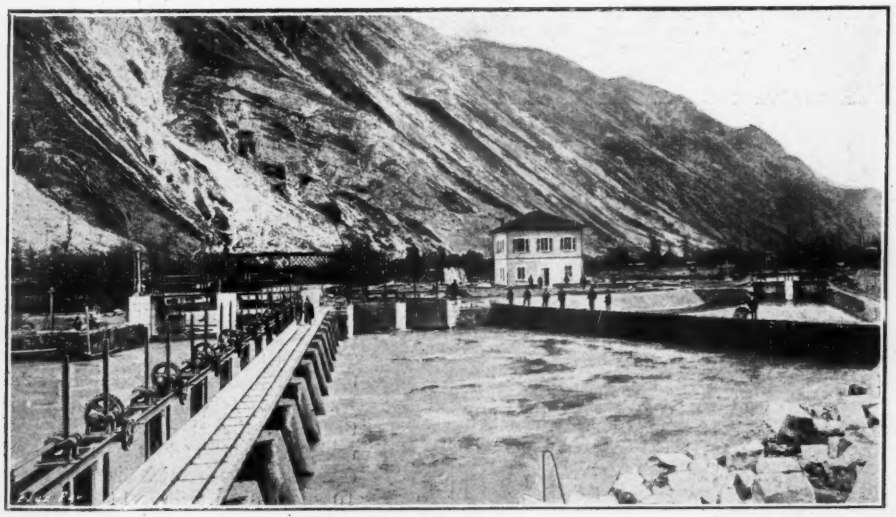


Fig. 2.—View of the Intake Works.

Several other works are projected, and, among these, a large carbide factory will be erected shortly at Piano d'Orte, as soon as the additional hydraulic works in connection with those which it is proposed to describe in this article are completed. The Electro-Chemical Co., which started the hydraulic works in connection with its factory at Bussi, obtained a concession for diverting 1,060 cb. ft. of water per second (30 m.³) from the Pescara below its junction with

the River Tirino, and delivering the same at Piano d'Orte, obtaining thereby a fall of 325 ft. 6 in. (99·2 metres). This fall was divided for the convenience of construction, and to meet the progressive requirements of the factories to which it was to supply power, into two portions: a first fall, with a generating station at "Tramonti," of 90 ft. 6 in., producing 8,400 effective H.P.; and a second fall, with a generating station at Piano d'Orte, of 235 ft. (71·60 m.), developing 22,000 effective H.P.

The combined efficiency of the pipe lines and turbines is estimated at 77·67 per cent. of the theoretical horse-power due to the fall. The works for diverting the Pescara for the first fall are situated on the right bank between the Provincial Road from Popoli to Chieti and the river at a short distance below its confluence with the Tirino, and consist of (1) a dam; (2) a weir; (3) a weir basin with spillway and outlet channel; and (4) sluice gates (figs. 2 and 7).

The dam consists of five spans of 16 ft. 5 in. (5 m.) each divided by piers in dressed stone, 4 ft. 3 in. (1·50 m.) in width, closed by metallic gates 6 ft. 7 in. (2 m.) in height, worked by hand. A foot bridge resting on the piers provides for the convenient working of the gates. By means of this dam, and the working of the gates, the level of the water is maintained constant in front of the weir.

The spans are sufficiently wide to present no obstacle to the highest floods known in the Pescara. Above the dam an ample basin of calm water is thus produced, from which the water is admitted to the diversion through a weir composed of 12 skew spans 9 ft. 10 in. (3 m.) by 2 ft. 7½ in. (0·80 m.), separated by piers built in reinforced concrete. These skew spans are furnished with metallic gates worked by hand, the sills of which are placed 2 ft. 11½ in. (0·9 m.) higher than the bed of the river to prevent the gravel and sand from being carried into the weir basin. The latter has a grating placed across it 111 ft. 6½ in. (34 m.) in length to stop floating matter, and on the left-hand side is provided with two openings to discharge the sediment. The left bank is provided with a locked aperture to return any surplus diverted water to the main stream, and to maintain the water level in the admission spans at a constant height. At the further end of the weir basin is situated the opening admitting the water to the canal, consisting of two spans of 11 ft. 2 in. (3·40 m.) by 9 ft. 8 in. (2·95 m.), each furnished with an iron gate. The grating, the gates, and all appliances connected therewith were provided by the National Works, of Savigliano. Through the weir-basin locks the water is admitted to the canal, which, for a length of 75 ft. 5½ in. (23 m.), is rectangular in section, and 24 ft. 11 in. (7·60 m.) in width; then by easy gradations the section becomes trapezoidal with sides inclined at an angle of 45° and lined with cement concrete. This canal, which is 344 yd. (314·2 m.) in length, has a fall at the rate of 5 metres in 10,000. It has a free cross-section of 278 sq. ft. (25·80 m.²), and is capable of conveying up to 1,413 cb. ft. per second. The canal is laid out in the strip of land between the railway and the Provincial high road parallel to the latter, and enters the tunnel section at the road crossing. The tunnel is excavated in the side of the mountains enclosing the Valley of the Pescara, and runs almost parallel to the line of the high road, its length being 2,444 yd.; it is entirely excavated in the rock, the sides being lined with rubble walling and the invert with cement. The section is rectangular, 10 ft. 8 in. by 14 ft. 9 in., and is covered by a vaulted roof with a rise of 2 ft. 11½ in. The fall is at the rate of 8 metres in 10,000, with a free cross-section of 187½ sq. ft.

The work of excavation of the tunnel was rendered more difficult along a considerable portion of its length by abundant springs of water, which retarded the advance and rendered special precautions and drainage necessary to get rid of the water during the period of construction. The tunnel ends in a pressure tank of the capacity of

Fig. 3.—Pressure Tank and Pipes.

Fig. 4.—Generating Station, Tramonti.

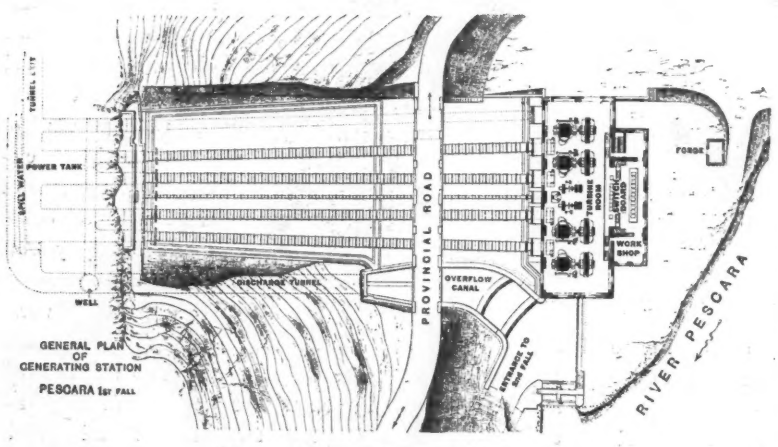


Fig. 5.—Plan of Generating Station.

2,289 cb. yd. (1,750 m.³), excavated entirely in the rock, which consists of a vaulted chamber, 98 ft. 5 in. in length and 26 ft. 3 in. wide, running parallel to the face of the work; from this two transverse chambers start, each 42 ft. 8 in. wide and 25 ft. 7 in. long, at the end of each of which are situated the entrance chambers for two pipes. A third vaulted tunnel has also been excavated, 3 metres in width, in which a fifth pipe will eventually be placed to utilise the surplus water (fig. 3).

Each entrance chamber for the pipes is 23 ft. long by 9 ft. 2¼ in. wide, and is furnished with iron gates and gratings to stop floating bodies. The big rock piers which separate the transverse tunnels communicate by longitudinal tunnels 7 ft. 6½ in. wide and 2 ft. 3½ in. high, which were pierced to provide a communication between these tunnels and ensure a perfectly uniform water level in front of each of the pipes and a uniform supply for the turbines.

In front of the pipe openings and for the entire length of the work a canal 7 ft. 6½ in. in width with its bottom 8 ft. 2½ in. lower than the inverts of the openings has been excavated to collect the sediment and other deposits from the water.

The main longitudinal tunnel comprises a spill-way 98 ft. 5 in. in length with the overflow channel pertaining thereto, and is provided at its termination with a relieving channel. This channel, together with the overflow channel of the spill-way and the outflow of the sediment tunnel, discharges into a well 11 ft. 6 in. in diameter and 59 ft. in depth, also wholly excavated in the rock. This well communicates with a tunnel 210 ft. in length and 172¼ sq. ft. in cross-section, terminating in a discharge channel arranged in steps and smaller wells which empty into the collecting basin.

From the pressure tank the water is led to the generating station, through four pipes 6 ft. 10½ in. in diameter, serving the main turbines, and one 1 ft. 11½ in. in diameter for the exciting turbines. The pressure pipes, which are each 308 ft. in length, and are designed to deliver 353 cb. ft. per second, are of soft steel riveted, $\frac{3}{16}$ in. to $\frac{9}{32}$ in. in thickness, stiffened by angle-iron rings disposed about 5 ft. 11 in. apart. The system of supports for the pipes deserves some mention; it is formed of bent rails on which the pipe rests, with cast-steel shoes fixed to the stiffening angle irons. Each pipe is provided at the upper end with a sliding expansion joint 13 ft. 1½ in. in diameter. The pipes cross the Provincial road by passing under the arches of a viaduct with five spans of 16 ft. 9 in.; the discharge channel also passes through an arched space of 26¼ ft. span (fig. 4).

The pipes and all accessories were provided by Messrs. Larini Nathan & Co., of Milan, and the gates and gratings by the National Company of the Savigliano Works. The generating station is a large building erected on the banks of the Pescara at such a level that it cannot be affected by the highest floods. It consists of a machine hall of 147⅔ ft. × 49 ft. 3 in. and 39⅓ ft. in height, covered with an iron roof, having an annexe of 103⅓ ft. × 22 ft. 11½ in. of two stories, on the ground floor of which are placed the switchboards, the transformers, and a workshop for repairs; on the upper floor are the chambers for the starting points of the distribution lines, and five living rooms (fig. 4).

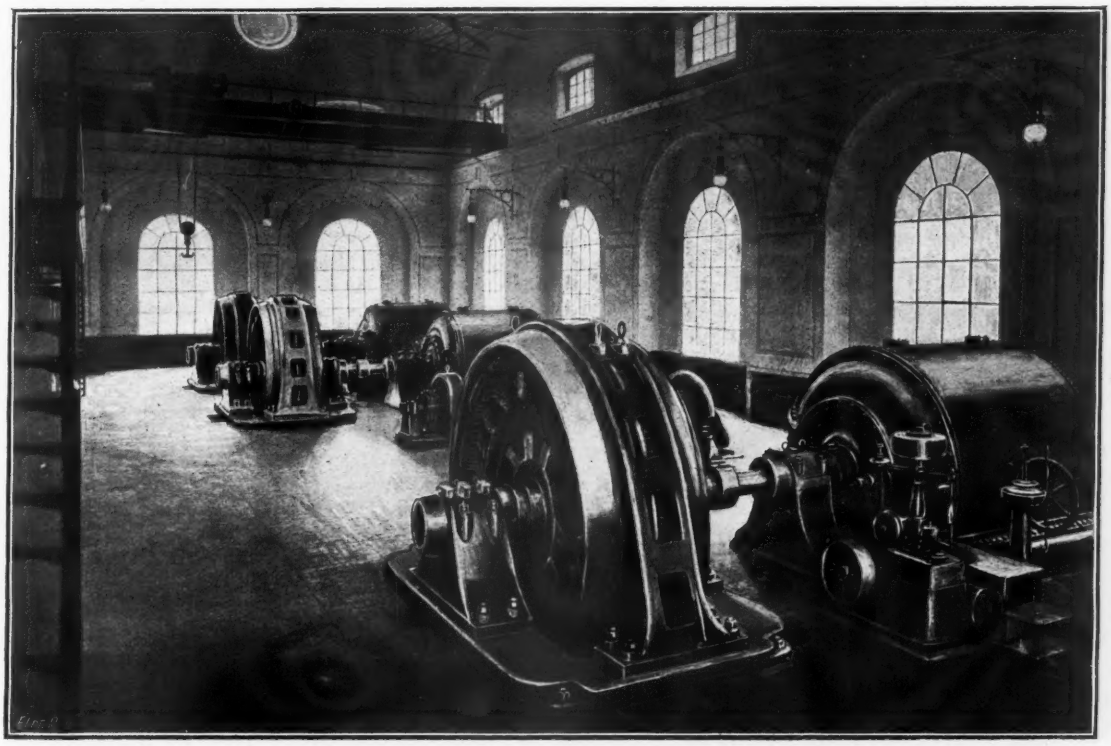


Fig. 6.—Interior of Generating Station.

Below the machine room are placed the culverts for the junction cables, connecting the alternators with the line switchboards, as well as the store-rooms for current supplies.

The machine room is provided with an overhead electrical traveller of the capacity of 20 tons. The machines consist of four turbine-alternator units, generating 2,800 H.P. at 270 R.P.M., mounted on the same shafts, and two turbine-dynamo units of 150 H.P. each to excite the alternators, one generating group of 2,800 H.P., and one dynamo of 150 H.P. being held in reserve (fig. 6).

The turbines were constructed by the engineering firm of A. Riva Monneret & Co., of Milan.

The main turbines are double suction turbines of the Francis type with distributors and movable vanes, designed to fulfil the following conditions:—Head, 90¼ ft.; speed, 270 revolutions; power, 2,800 H.P. Each turbine is provided with a governor and an automatic auxiliary motor. The two small turbines are spiral turbines of the Francis type constructed to suit the following conditions:—Head, 90¼ ft.; speed, 400 revolutions; power, 180 H.P.

The turbines discharge into a canal 24⅔ ft. in width, running under the flooring of the station and

delivering into the basin communicating with the Pescara and the entrance to the tunnel for the second fall.

The alternators, the exciters, and the switchboards were constructed by the Italian Electrotechnical Union (Gadda and Co., Brioschi Finzi & Co.), of Milan.

The alternators, which are provided with revolving fields, generate current at 6,000 volts and 45 periods. The switchboards and switches, &c., are enclosed in cement cells,

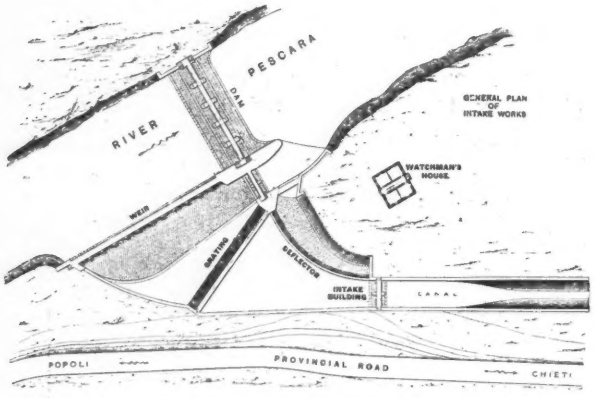


Fig. 7.—Plan of Intake Works.

so as to secure the maximum working safety. These cells are placed in the machine room under a large operating gallery at 9 ft. 10 in. above the ground. In this gallery are disposed on suitable supports the measuring instruments and the levers for working the switches and the rheostats. The machines and the lines are connected on the ring-and-bridge system. The distributing pressure for the principal consumers is 6,000 volts, but as a portion of the current has to be transmitted to a considerable distance on account of the Abruzzese Co., this portion is transformed to a pressure of 25,000 volts by a step-up transformer, composed of four single-phase units (one in reserve) of 150 K.V.A., which are disposed star fashion so as to form one three-phase transformer of 450-K.V.A. capacity. The primaries and secondaries of these transformers are each provided with measuring instruments and knife switches, to enable them to be easily inserted into or withdrawn from the circuit.

Close to the generating station a house has been erected to accommodate the resident staff.

From the generating station start three distribution lines, viz.:—

1. The line of the Aluminium Co. which unites the generating station with the works of the said company at Bussi; pressure 6,000 volts, length 2·05 miles, formed of six wires of 0·12 sq. in. section, supported by strong and handsome iron standards supplied by the Savigliano Co.

2. The line for the Azote Co., which connects the central station with the works of the said company at Piano d'Orte, pressure 6,000 volts, length of line 6·21 miles, formed of three wires of 0·07 sq. in. section, supported on wooden standards.

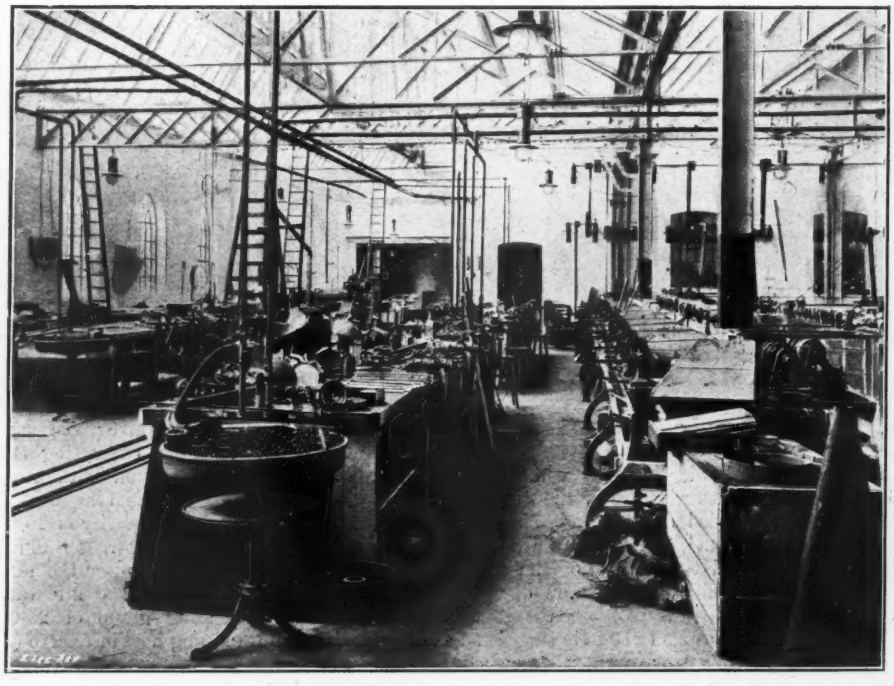
3. The line of the Abruzzese Electrical Undertakings Co., which reaches to Castellamare and Francavilla, with a pressure of 25,000 volts, formed of three wires of $\frac{13}{64}$ in. diameter.

All the above lines are provided with automatic switches and lightning arresters of the Siemens-Wurz type, and water jets.

The works of the second fall are actively progressing, and should be completed some time next year, when the full amount of power (30,500 H.P.) for which the concession was granted will be available for manufacturing purposes between Bussi and Piano d'Orte.

MESSRS. VERITYS' EXTENSIONS.

Since the date of our description of the Plume and Victoria Works of Messrs. Veritys, Ltd., at Aston (see Electrical Review, March 2nd and 9th, 1906), further extensions have been made, a new modernly designed and equipped shop having been put up on ground which previously formed a yard between the two wings of Plume Works. This extension was necessitated by the increased business of the firm in art fittings, radiators, &c. The accompanying illustration shows this extension, where ornamental fittings and ships' and engineering fittings are in course of manufacture. The actual floor-space is 200 ft. × 70 ft., and the considerable equipment that has been added includes several new drilling machines, &c. A motor-driven shaft arranged near the ground runs along each row of lathes, a plan which has the advantage of dispensing with all overhead belting and shafting.



Veritys' New Fittings Shop at Aston.

No sooner had this extension been completed than it was found necessary to consider further extensions in the motor and dynamo department, and these are to be put in hand forthwith. Overtime has been worked in this department for many months past. We understand that the firm now recognise that the only way to continue to deal with orders promptly is by putting down a considerable quantity of new plant.

TELEGRAPH and TELEPHONE NOTES.

(*Continued from page 770.*)

New Cable.—The Eastern and South African Telegraph Co. are about to lay a direct cable between Mozambique and Durban, which will probably be done towards the end of this month. They also intend to connect the towns of Beira and Quelimane, in Portuguese East Africa, with the cable already existing between Mozambique and Lourenço Marques.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Curacao-Coro Curacao-La Guayra Curacao-Maracaibo } Closed..	Jan. 12, 1906 ..	..
Tarifa-Tangier	Jan. 18, 1904 ..	..
Port Arthur-Chifu (Closed)	Mar. 9, 1904 ..	..
Garachico-Santa Cruz	July 12, 1906 ..	..
Las Palmas-Arecife	Aug. 18, 1906 ..	..
Brest-Dakar	July 22, 1907 ..	..
Pernambuco-Ceara	Oct. 9, 1907 ..	Oct. 30
Guernsey-Jersey	Oct. 19, 1907 ..	Nov. 2
Katonou-Lagos	Nov. 2, 1907 ..	..
Landlines.		
Puerto-Barrios	Aug. 2, 1909 ..	..

Telephone Calls.—A case was tried by Mr. Justice Edge last week, in which the National Telephone Co. sued H. Rackow for 18s. 9d., telephone call fees due. The defendant paid 14s. 8d. into Court, this sum representing the calls that he had made, as recorded in his register of calls. The plaintiffs claimed that Clause 11 of the agreement bound the defendant to accept the records of the company as conclusive evidence of the number of calls, but the Judge said that the book produced by plaintiffs was not evidence, as the person who made the entries was not present. He considered that the clause would probably be held to be an unreasonable one. Verdict for the defendant above the amount paid into Court.

CONTRACTORS' COLUMN.

Openings for New Business.

ABERCRAVE (Breconshire).—Ancient Briton Inn to be rebuilt. E. Evans-Bevan, lessee.

ABERDEEN.—Polishing mill and stone-dressing shed in Pittodrie Place, for Cale & Rettie, sculptors. D. Hodge, architect, Aberdeen.

AINSDALE.—Office for J. Ward & Sons, Liverpool Road. J. Ward.

ASHTON-IN-MAKERFIELD.—Proposed new school for Billinge and Orrell. (accommodate 400).

AUCHTERDERRAN (Fife).—New school at Cardenden Station. Wm. Williamson, F.R.I.B.A., architect, Royal Bank Buildings, Kirkcaldy.

BAMFORD.—Enlargement of the National Schools for the Derbyshire C.C.

BATH.—New Post Office premises in Northgate Street.

BIRNAM.—Double villa in Dunkeld Road by Mr. Dunbar, joiner, Birnam.

Alterations to Merlewood House, with new stables and coachman's house, for Miss Beveridge, Merlewood.

BRENTWOOD (Essex).—"Grinstead Hall" (£784). H. R. Bird, St. Thomas' Gate, Brentwood, architect; J. W. Parish, Hutton, builder.

BRISTOL (Totterdown).—New Fire Station for the T.C. (£3,000).

Important extensions at the City Lunatic Asylum. Peter Addie, City Valuer, The Exchange, Bristol.

BROADSTAIRS.—New place of worship lit by electricity (£1,168). Woodhall and Son, builders, Ramsgate.

Nursing Home in Ramsgate Road. Messrs. Dowker.

CARDIFF (Cathays).—New Church of St. John's (£9,000). Rev. A. Henderson, Vicar.

CHELMSFORD.—New Education Offices for Essex C.C.

CHORLEY (Lancs.).—New ring spinning mill at Coppull, for Mavis Spinning Co. (new concern).

COLCHESTER.—Proposed new Cathedral.

CORK.—Model Village.

CORWEN (N. Wales).—Minister's House. G. D. Lewis, architect, Talbot Chambers, Shrewsbury.

COVENTRY.—Proposed extension of the County Hall for the Warwickshire C.C.

CULLEN (Banffshire).—Additions and alterations to school. W. K. Gray, Portsoy, builder.

CULTRA (Co. Down).—Residence for F. J. Heyn. H. Seaver, architect, Belfast.

DENBIGH.—Villa residence in Craig Road. J. D. Lewis, architect, Denbigh.

DOUGLAS (Isle of Man).—Important extensions to the Hospital (£10,000). Henman & Cooper, architects, 19, Temple Street, Birmingham.

DUNDEE.—Extensions at Harris Academy (£2,500). Mr. Langlands, architect to the School Board.

Duty-paid premises at Messrs. Watson's Bond. Johnston & Baxter, architects, Dundee.

Alterations to shop for James Ramsay's trustees, High Street.

EXETER.—Additions to Wesleyan Chapel in Fore Street. R. M. Challice, architect, Exeter.

GLASGOW.—New school for Cathcart School Board.

HANLEY (Northwood).—New Wesleyan Schools. Wm. Campbell, architect, 2, Bagnall Street, Hanley; W. Thomas & Son, builders, Grafton Street, Hanley.

HASLINGDEN.—New cotton shed. A. Worsley & Co.

HERTFORDSHIRE.—Alterations and additions to Sawbridgeworth Council School. M. A. Smith, county surveyor, Hatfield.

HEXHAM.—Offices and greenhouses at the Wentworth Nurseries.

HUDDERSFIELD (Fartown).—Villa residence. Arthur Shaw, architect, Golcar.

HULL.—Important additions to the works of the St. Andrew's Engineering Co. Freeman, Son and Gaskell, architects, 11, Carr Place, Hull.

HUNSTANTON.—New Council School for Norfolk C.C. H. J. Green, architect, Castle Meadow, Norwich.

ILFORD.—New Cecil Hall in connection with St. Clement's Parish Church (£3,000). Rev. H. W. E. Molony, vicar.

ILFRACOMBE.—New elementary school at Shephard's Park.

IVYBRIDGE (Devon).—Extensive paper mills to be established by John Henry and Co., Ltd., 6, Ludgate Square, London.

KELSO.—New General Post Office.

KILKENNY (Ireland).—New Free Library.

LIVERPOOL.—Extensive block of business premises in Charlotte Street. W. Aubrey Thomas, architect, 5, Castle Street, Liverpool.

Extensive business premises in Great Charlotte Street, electrically equipped for R. J. Blackler. W. Aubrey Thomas, architect, 5, Castle Street, Liverpool.

LONDON (Bermondsey).—Re-building Ship Aground public house, for Courage and Co., Shad Thames, brewers.

(Camden Town).—Enlargement of slaughtering houses at rear of 61-69, Park Street, for Lidstone, Ltd., 76, Park Street, Camden Town, butchers.

(Tottenham).—Additions to factory in Derby Road. Rowley Bros., West Green Road, Tottenham, builders.

(Tottenham).—Additions and alterations to laundry for Oceana Laundry, Ltd., Cornwall Road, Stamford Hill, N.

(Tottenham).—Lodge and stables. Truman, Hanbury, Buxton and Co., Ltd., Crownstone Road, Brixton, S.W., brewers.

(Tottenham).—Warehouse for Edmonton Co-operative Society, 57, Church Road, Tottenham.

(Greenwich).—Additions to Borough Hall (£800). Alfred Roberts, 92, London Street, S.E., architect.

(Leyton).—Alterations to Nos. 389, 391 and 393, Hoe Street. J. & J. Dean, Knott's Green Road, Leyton, builders.

(City).—Building on site of 21, Cock Lane, Giltspur Street. G. D. Martin, 3, Pall Mall East, architect.

(Clapham Common).—Development of Battersea Rise House Estate for building purposes. E. Evans, 253, Lavender Hill, S.W., agent.

(Lewisham).—Twenty-six houses and one shop. Eastman Bros., Sydenham, S.E., agents.

(Lewisham).—Addition to depository for Chiesman Bros., drapers, &c., 35-59, High Street, Lewisham, S.E.

(Holloway, N.).—Postal sorting office (£2,200). J. & W. Drake, 195, Hammersmith Road, W., builders.

(Brixton).—School in Acre Lane (£2,900). T. T. Bailey, architect, Education Department, Spring Gardens, S.W.

(Battersea).—"Dream City" (place of entertainment) to be lit by electricity. J. W. F. Bennett, 21, Langham Mansions, Kensington, W.

(Strand).—Hotel on site of Exeter Hall and St. Michael Church. Allen & Son, 17, Carlisle Street, W.

(Wandsworth).—21 houses in Harborough Road, Streatham. F. T. Wooding & Son, 3, Harborough Road, S.W., builders.

(Wandsworth).—Additions to schools in Christchurch Road, Streatham. G. Chandler & Sons, 258A, Brixton Hill, builders.

(Streatham).—Laundry, Garrad's Road. J. & J. Uglow Bros., 59, Trinity Road, Balham, builders.

(W.C.).—Two blocks of maisonettes in Winscombe Street. George Taft, 51, Linzee Road, Hornsey, N.

(Hammersmith).—Installation of electricity for working two lifts. Secretary, West London Hospital, Hammersmith Road, W.

(W.C.).—Building on site of 14, Green Street. Hillier & Parker, 99, Regent Street, W., agents.

(Woolwich).—Laundry, stables, &c., in Nightingale Vale. Mrs. M. Lister, 1A, Eleanor Road, Woolwich.

LUTON.—Electric installation at the secondary school for the T.C.

Extensive new works in Biscot Road for G. B. Kent and Sons, Ltd., High Holborn, London.

MANCHESTER.—New public elementary school at Fallowfield for 1,200 children for the T.C. W. H. Talbot, Town Clerk, Manchester.

New Wesleyan Church, Gorton (£5,000).

METHIL (Fife).—Theatre (seat 1,000) and shops. Swanson & Syme, architects, Methil.

Eighteen dwelling houses and nine shops for Methil Land and Property Investment Co. Mr. Birrell, architect, Kirkcaldy.

MIDDLETON.—New Secondary School for the Local Education Authority (£13,800).

NORTH SHIELDS.—New secondary school in Hawkey's Lane. J. C. Maxwell, 25, Eldon Square, Newcastle, architect; J. L. Miller, North Shields, builder.

OSWALDTWISTLE.—New weaving shed (900 looms) for the Roe Greaves Commercial Mill Co., Ltd.

POPPLETON (Yorks).—New parish hall and Sunday school.

RAMSGATE.—Auction rooms, &c., in St. Peter's Road. B. Beach, Broadstairs.

REDRUTH.—New police station, &c., for Cornwall Standing Joint Committee. O. Caldwell, architect, Penzance.

REIGATE (Chaldon).—Residence in Rook Lane for L. G. C. Money, M.P., Maida Vale, W.

ROTHERHAM (Mexborough).—Extension of market. G. F. Carter, surveyor to the Council, Council Offices, Mexborough.

SEDGEFIELD (Ferry Hill).—Electric light to be installed at the Manor House and Workhouse for the B.G.

SHEFFIELD.—Important alterations and extensions at the Union offices for the B.G. (£4,500).

New school in connection with Old Whittington Primitive Methodist Chapel. Also renovation of the chapel.

SLOUGH.—Important extensions at the Parish Church (£7,500). Mr. Scott, architect.

STYAL (Cheshire).—Extensive additions to Styal Children's Homes for Chorlton B.G. J. W. Beaumont & Sons, architects, 10, St. James Square, Manchester.

SWANSEA.—New schools for Girls in Walter Road for the T.C. (£6,000).

TIDEFORD.—Proposed new Wesleyan Chapel.

WALKDEN (Near Manchester).—Important extensions at Burgess, Ledward and Co.'s Wardley Mills.

WALLASEY.—New High School for Girls for Cheshire C.C. Appleyard and Quiggin, architects, 67, Lord Street, Liverpool.

WARRINGTON.—New central offices for local Co-operative Society. Secretary, Co-operative Society, Warrington.

WATFORD.—Store for Co-operative Society. W. H. Syme, 4, High Street, Watford, architect.

WHITEHAVEN.—New Council School for the T.C. (£10,000 to £15,000).

WIGAN.—New spinning mill for the Empress Spinning Co., Ltd.

WILLESDEN.—Show-room and workshop. W. E. Sanders, 118, Camden Road, N.W., architect.

(Willesden Green).—Alterations to shop, &c., 37, Walham Lane, for the Hygienic Bakery Co.

WINDSOR.—New King Edward VII.'s Hospital.

WOLVERHAMPTON.—Block of shops, offices and business arcade in Queen Square and Victoria Street. F. T. Beck, architect, Darlington Street, Wolverhampton.

New Unitarian Church, corner of Connaught Road (£3,000). Rev. J. A. Shaw, M.A., pastor.

CONTRACTS OPEN and CLOSED.

OPEN.

Altona.—November 15th. The Building Department of the town requires tenders for a fixed electrical crane of 8,000 kg. capacity. Particulars may be obtained from the Bau-Commission, Rathaus II, Room 112, against payment of 1s.

Australia.—South Australia. January 8th, 1908. One common-battery switchboard and 3,000 subscribers' telephones. Commonwealth Office, 72, Victoria Street, S.W.

Melbourne.—December 17th. Five sections of telephone switchboard for Central Telephone Exchange, Victoria.*

Melbourne.—80 A.C. flame arc lamps for the City Council. See "Official Notices" November 1st.

Brisbane.—December 16th. Insulators, iron spindles and copper wire for the P.M.G.*

Port Adelaide.—March 11th. Common battery switchboard, subscribers' telephones and protectors.*

Perth (W.A.).—December 16th. Postmaster-General's Department: 80 accumulators for telegraph purposes, &c. See this column for last week.

Sydney, N.S.W.—Meters for the Municipal Council. See "Official Notices" November 1st.

Bremen.—November 13th. The K. Eisenbahnmaschinen-inspection requires tenders for two electric cranes for loading coal. Specifications may be obtained by sending 1s. cash and 2½d. postage to that authority.

Brussels.—December 31st. The Commandant du Génie requires tenders for the electric lighting of Military School. Specifications, 1s. 8d., from 40, Rue de Reutiers. A deposit of £240 is required.

Buenos Ayres.—The Public Works Department requires tenders for laying and equipping two new telegraph lines.

Chatham.—November 21st. The B.C. requires tenders for the annual supply of incandescent electric lamps.

Dublin.—November 11th. Stores for the Dublin United Tramways Co. (1896), Ltd. See "Official Notices" October 25th.

East Stonehouse (Devon).—The U.D.C. invites tenders for the installation of fittings, wiring, lamps and accessories in the Town Hall Buildings. C. H. Trounce, surveyor, Town Hall.

France.—Paris.—Under-Secretary for State for Post and Telegraphs. New Central Exchange (estimated cost over £50,000). Names by November 11th to Sous Secretariat, 103, Rue de Grenelle.

Glasgow.—The Workshops Committee of the Clyde Trust have instructed that the firms who had formerly offered for the electric cables for Rothesay Dock be invited to tender for the cables required for the remainder of the dock.

The mechanical engineer was instructed by the Committee to invite tenders for the 2-ton electric crane, recommended by the Traffic Committee to be provided at Berth No. 1, south side.

Gloucester.—November 9th. Stores for the Light Railways Committee. See "Official Notices" October 25th.

G.W. Railway.—November 12th. Stores for one year. See "Official Notices" October 4th.

Liverpool.—November 21st. The Cheshire Lines Committee requires tenders for annual supplies, including telegraph and permanent way materials. Particulars from Mr. Glegge Thomas, secretary, Central Station, Liverpool.

London.—November 11th. Electric fittings, engineers' goods, tramcar fittings, &c, for one year, for the L.C.C. See "Official Notices" November 1st.

* Specifications at Commercial Intelligence Office, Board of Trade, 73, Basinghall Street, E.C. Tender forms at Commonwealth Offices, 72, Victoria Street, S.W.

Manilla.—January 15th, 1908. Sewage pumps to be worked by electric motors are required by the municipal authorities.

Montreal.—A Canadian correspondent writes as follows: "Open to the World.—Advertisements will be inserted in Canadian, American and European newspapers by the city of Montreal, calling for tenders for the supply of gas and electricity. Judging from the remarks made at the meeting of the Fire Committee when this decision was arrived at, it is not the intention to encumber the advertisements with too many details about conditions existing in Montreal; a free hand will be given to the tenderers to say what they will do, and after that the city will decide what to accept."

New Zealand.—December 11th. The Napier T.C. requires tenders for electric tramways, lighting and power supply. Frank N. Bower, Town Clerk.

Peterborough.—November 21st. Feeder cables for the Electricity Committee. See "Official Notices" to-day.

Stepney.—November 11th. Steam and electric generating plant, &c., for the Council. See "Official Notices" October 11th.

Trent.—November 23rd. Mains and services, balancer and booster, and switching apparatus for the Electricity Committee. See "Official Notices" to-day.

CLOSED.

Australia.—Queensland.—According to *Australasian Hardware and Machinery*, the Botanical Gardens at Brisbane are to be lighted with electricity, the Government having accepted the tender of Messrs. Lawrence & Hanson for a complete installation with underground cables, at £1,830.

Brisbane.—Postmaster-General:—Brisbane Electrical Co., 80 coin attachments, £1 4s. 6d. each.

Australasia.—Tasmania.—Postmaster-General's department:—British Insulated & Helsby Cables, Ltd., 880 yd. silk and cotton-insulated cable, 21 conductors, 9d. per yd. J. Bartran & Son, 1,080 subscribers' service meters, 8s. 6d. each; one meter rack, £30.

Chester.—The Electric Lighting Department has accepted the tender of Pope's Electric Lamp Co. for the supply of incandescent lamps for one year.

Cleckheaton.—The U.D.C. has accepted the tender of Messrs. W. T. Glover & Co., Ltd., for the supply of cables.

Dundee.—In connection with the contracts just allocated for the new generating station to be erected at Carolina Port by the Corporation, the following tenders were submitted:—

1,045 yd. Three-core Armoured Cable, in Sections; also 1,202 yd. ·3 in. × ·1 in. × ·3 in.; 2,790 yd. Single Lead-Covered Cable; and 1,395 yd. Ditto.

Lahmeyer Electrical Co.	£1,400
Siemens Bros. & Co. (accepted)	1,575
Land and Sea Cables Co.	1,602
British Insulated and Helsby Cables Co.	1,615
Johnson & Phillips	1,646
Western Electric Co.	1,694
W. T. Henley's Telegraph Co.	1,702
Callender's Cable and Construction Co.	1,839

For Two 2,000-kw. Turbo-Alternators.

Siemens Bros. & Co.	£16,990
Brush Electrical Engineering Co.	17,033
Parsons, Ltd.	17,440
Electric Construction Co.	17,679
General Electric Co.	18,435
British Westinghouse Co.	18,593
Willans & Robinson (accepted)	18,676
Jas. Howden & Co.	19,349
Richardsons, Westgarth & Co.	20,610
British Thomson-Houston Co.	20,212
Electrical Co.	28,764

Boilers.

Stirling Boiler Co.	£6,880
Clarke, Chapman & Co.	6,884
Babcock & Wilcox (accepted)	7,080
Rowland & Co.	7,490

Chain-Grate Stokers.

Babcock & Wilcox (accepted)	£1,675
Stirling Boiler Co.	1,715

Economisers.

Messrs. Green	£1,590
Babcock & Wilcox (accepted)	1,600
Messrs. Lowcock	1,605

Railway Siding.

Bennis & Co.	£343
New Conveyor Co.	411
Spencer & Co.	520
Stirling Boiler Co.	560
Babcock & Wilcox (accepted)	595

Bunkers, Conveyors, &c.

New Conveyor Co.	£3,005
Spencer & Co.	3,160
Stirling Boiler Co.	3,780
Babcock & Wilcox (accepted)	3,775
Bennis & Co.	5,843

Glasgow.—The offer by Messrs. John Finlay & Co. for the electric wiring of the Clyde Trust's new offices has been accepted, at £198. This was the lowest offer.

Hull.—The Corporation E.L. Committee has let the next half-yearly contract for the supply of coal to the power station (Hickleton Main Colliery best screened hards and unwashed slack) to Messrs. Bannister & Co.

London.—MARYLEBONE.—The B.C. has considered the following tenders for the supply of 440 yd. 1-sq. in. cable, required for additions to the distributing network:—

W. T. Henley's Telegraph Works Co.	(accepted)	£278
Siemens Bros. & Co.		283
W. T. Glover & Co.		283
St. Helens Cable and Rubber Co.		322
Callender's Cable and Construction Co.		338

L.C.C.—The Highways Committee of the L.C.C. has received the following tenders for the wiring and fittings for the Holloway tramway car-shed and the tramway sub-stations at Holloway, Hackney and Clapton:—

Pinching & Walton	(recommended)	£2,374
W. G. Cannon & Sons..		2,741
Revy, Phillips & Co.		2,754
Lacy & Co.		3,992

Salford.—The T.C. has accepted the tender of the General Electric Co., Ltd., for electric light fittings for Broughton Town Hall, at £77, and that of Messrs. Davenport, Sparrow & Co., 45, Blackfriars Street, Manchester, for wiring the building, at £73.

Willesden.—The U.D C. has accepted the tender of the Aron Electricity Meter Co. for the supply of 300 alternating-current meters, at 32s. 6d. each. For the supply of a second-hand electric 3-ton travelling crane, the tender of Messrs. Walter Scott and Middleton, Ltd., at £290, has been accepted.

Wolverhampton.—The District Electric Co., of Wolverhampton, has received the order to carry out an installation for electric lighting, bells and telephones at the Wolverhampton and Staffordshire General Hospital Nurses' Home, now in course of erection.

FORTHCOMING EVENTS.

To-day's Events (Friday, November 8th).—Meeting of the Northampton Institute Engineering Society. Debate on "The Relative Merits of College and Workshop Training for the Engineer."

At 8 p.m. At the Royal College of Science, Imperial Institute Road, S.W. Physical Society. Discussion on Mr. Campbell's paper on the use of variable mutual inductances; also papers by Mr. L. F. Richardson and Dr. J. Morrow.

Saturday, November 9th.—At 10 a.m. sharp. Institution of Electrical Engineers, Students' Section. Visit to the Bow Works of the North London Railway.

Monday, November 11th.—At 8 p.m. Institution of Mechanical Engineers Graduates' Association. Paper by Mr. H. E. Morgan on "Railway Signalling."

Tuesday, November 12th.—At 7.30 p.m. At the Physical Laboratory of the University of Manchester. Institution of Electrical Engineers, Manchester Section. Mr. M. B. Field, Chairman's address.

Wednesday, November 13th.—At 8 p.m. St. Bride's Institute, E.C. Association of Engineers-in-Charge. Presidential address by Mr. W. H. Patchell on "Economic Considerations on the Management of Plant."

Thursday, November 14th.—At 8 p.m. At the Royal College of Science, Dublin. Institution of Electrical Engineers (Dublin Local Section). First meeting of the session.

At 8 p.m. At the Institution of Civil Engineers. First meeting of the session, of Institution of Electrical Engineers. Paper on "The Dielectric Strength of Insulating Materials and the Grading of Cables," by Mr. A. Russell.

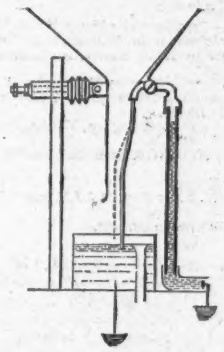
At 7.30 p.m. At the Colonnade Hotel, New Street, Birmingham. Monthly meeting of the Birmingham and District Electric Club. Paper on "Recent Developments in Single-phase Motors for Power and Traction." By Mr. V. E. Walters.

Friday, November 15th.—At 8 p.m. At the Institution House, Storey's Gate, St. James's Park. Institution of Mechanical Engineers. Mr. E. J. Way (Johannesburg), paper on "Labour-Saving Appliances at the Mines of the New Kleinfontein Co., Transvaal.

The Technolexicon.—Our readers will learn with regret that the Society of German Engineers has resolved to discontinue the Technolexicon, because the work has turned out to be expensive beyond all expectation, and the outlay required for its accomplishment within the allotted time exceeds the pecuniary means at the disposal of the Society for this purpose. All letters and other postal matter concerning the Technolexicon are henceforth to be sent to the "Verein Deutscher Ingenieure," Charlottenstrasse, 43, Berlin (NW. 7). We had hoped that on the completion of this important undertaking, a really comprehensive and reliable dictionary of technical terms would have been available. At present there is no technical dictionary on the market in English, French and German that can be described as at all adequate.

NOTES.

Water-Jet Lightning Arrester.—In the water-jet lightning arrester shown herewith, for which a United States patent was granted to Mr. S. Schneider, of Berlin, Germany, on September 17th, the connection to earth through the water-path is incomplete except when extra high potential exists on the transmission line; thus there is no constant consumption of energy. The arrester is of the horn type, the horn which is connected to the



SCHNEIDER WATER-JET ARRESTER.

ground being formed in part by a jet of water supplied through an insulating tube. Statically-charged water-drops in the jet are attracted by means of the opposite charge on the high-potential conductor, and hence when the charges are excessive the jet is deflected over against the conductor and a high-resistance path is formed from the conductor to the ground.—*Electrical World.*

Electrolytic Disinfectant in Poplar.—A report of the Public Health and Housing Committee of the Poplar Borough Council shows that the total cost of the electrolytic plant to date has been £596; during the last 20 months 27,320 gallons of disinfecting fluid of an average strength of 4·5 gm. of chlorine per litre have been manufactured, half of which has been distributed to the public, most of the remainder being supplied to the Works Department for watering roads, &c., at 1d. per gallon. The energy used was 4,098 units, costing at 1½d. per unit £25 12s. 3d.; salt, chloride of magnesium and caustic soda, and a small outlay for water, brought the total cost for electricity and materials up to £52 3s. 11d. Corks, bottles, cartage, &c., in the first 10 months amounted to £154 11s. 10d., but in the last 10 months these items have cost only £35 5s. 11d. Wages in 1905 for carbolic acid were £373 12s. 2d.; for the electrolytic fluid they were £340 14s. 8d. per annum.

Summing up, the whole outlay on electrolytic fluid for the 20 months was £882; if carbolic acid had still been used, the cost would have been £1,655, so that a saving of £773 has been effected by the use of the electrolytic method in 20 months, or at the rate of 46½ per cent. The whole of the capital outlay has thus been recouped, and £177 saved in addition. The plant is in good working order, turning out 185 gallons of fluid in eight hours; the zinc electrodes are good for 20 months longer. The saving will be greater, in future, as many items of expenditure will be avoided.

In recognition of his excellent work in successfully carrying out this scheme, Dr. F. W. Alexander, the medical officer of health, is to be presented with a testimonial by the Council. Other boroughs would do well to follow the example of Poplar.

Institution and Lecture Notes.—INSTITUTION OF ELECTRICAL ENGINEERS (MANCHESTER LOCAL SECTION).—The provisional syllabus of meetings for the new session, which opens on Tuesday, November 12th, at the Midland Hotel, with the address of the chairman, Mr. M. B. Field, is as follows:—

November 12th, 1907.—M. B. Field, M.I.E.E., Chairman's Address.
November 26th.—H. W. Wilson, A.M.I.E.E., "Further Remarks on the Electrical Operation of Textile Factories."
December 10th.—Thos. F. Wall, B.Sc., B.Eng., "The Reluctance of the Air-Gap in Dynamo Machines."
January 7th, 1908.—G. W. Worral, M.Sc., M.Eng., A.M.I.E.E., "Magnetic Oscillations in Alternators."
January 21st.—C. H. K. Chamen, A.M.I.E.E., "High-Voltage Transmission and Distribution (from a Mainsman's point of View)."
February 4th.—J. S. Peck, M.I.E.E., "Protective Devices for High-Tension Transmission Lines."
February 18th.—W. Hoult, M.Eng., B.Sc., A.M.I.E.E., "Direct-Current Turbo-Generators."
February 28th.—Annual Dinner.
March 3rd.—Prof. A. Schwartz, M.I.E.E., and W. H. N. James, A.M.I.E.E., "Investigations on the Operation of Enclosed Fuses."
March 17th.—Eustace Thomas, "The Management of Engineering Workshops."
March 31st.—Prof. W. W. H. Gee, A.M.I.E.E., "Electrolytic Corrosion."
April 14th.—General Meeting. M. Kloss, Dr.-Ing., "Alternating-Current Turbo-Generators."

The programme is specially marked "provisional," owing to the new regulations passed by the Council of the Institution regarding papers read, either in London, or at any of the provincial centres. These regulations may involve changes in the dates or subjects of

papers. All meetings, after the opening gathering, will be held at the Physical Laboratory of the University of Manchester.

The Royal Society.—At yesterday's meeting the following papers were to be read:—

W. Geoffrey Duffield: "The Effect of Pressure upon the Arc Spectra of Metals." Communicated by Prof. Schuster, F.R.S.

F. Soddy and T. D. Mackenzie: "The Electric Discharge in Monatomic Gases." Communicated by Prof. Larmor, Sec. R.S.

Prof. A. Schuster, F.R.S.: "The Diurnal Variation of Terrestrial Magnetism."

Prof. H. L. Callendar, F.R.S., and Prof. W. E. Dalby: "On the Measurement of Temperatures in the Cylinder of a Gas Engine."

The Hon. R. J. Strutt, F.R.S.: "Note on the Association of Helium and Thorium in Minerals."

Association of Engineers-in-Charge.—The programme for session 1907-8 is as follows:—

November 13th, 1907.—Presidential address by W. H. Patchell, M.Inst.C.E., on "Economic Considerations on the Management of Plant."

December 11th.—Paper by Leon Gaster, A.M.I.E.E., on "The Province of the Illuminating Engineer."

January 8th, 1908.—Paper by Kenelm Edgcumbe, A.M.Inst.C.E., on "Electrical Measuring Instruments and Some of their Weaknesses."

January 11th.—Social. Dance.

February 12th.—Paper by Thomas Sugden, Wh.Sc., on "Superheated Steam."

February 22nd.—Social. Dance.

March 11th.—Paper by H. D. Wilkinson, M.I.Mech.E., on "Notes on Electric Lifts."

March 28th.—Annual dinner.

April 8th.—Paper by W. A. Tookey, M.J.I.E., on "Indicators and Indicator Diagrams."

April 25th.—Social. Bohemian concert.

May 8th.—Annual meeting.

The foregoing programme justifies our suggestion that no engineer-in-charge can afford to remain outside the ranks of the Association. That it is a progressive Association, and alive to its responsibilities, is beyond doubt, and no effort is spared to assist its members in whatever direction they may seek aid.

Northampton Polytechnic Institute—The annual prize distribution and conversazione will be held on Friday and Saturday, November 29th and 30th. The Duke of Connaught, K.G., will distribute the prizes on November 29th, and after the prize distribution the whole of the laboratories, workshops, drawing office and studios of the Institute, both in the main building and in the British Horological Institute adjoining (the Technical Optics Department), will, as usual, be on view in working order. The conversazione of members and students will be held on the following evening in both buildings.

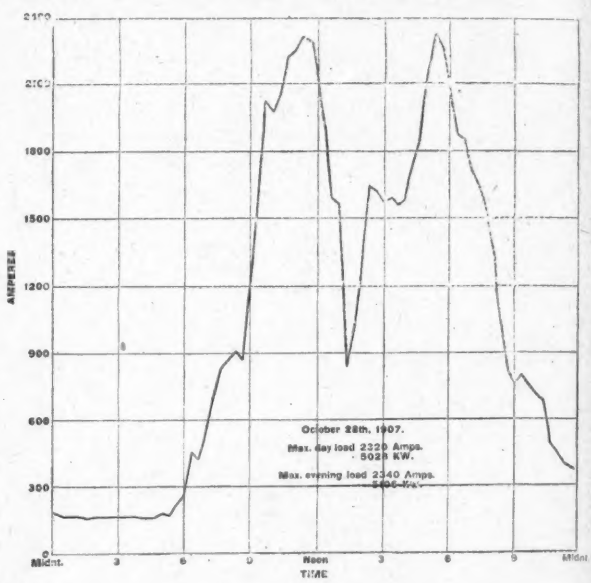
Institution of Civil Engineers.—The Council has made the following awards for the year 1906-7:—The Howard Quinquennial Prize to Mr. T. E. Vickers, C.B., in recognition of the part he has taken during his career in developing and improving the production of steel for important engineering purposes; Telford Gold Medals to Messrs. Dugald Clerk (London) and Mr. E. J. Way (Johannesburg); Watt Gold Medals to Messrs. J. T. Milton (London), A. W. Brightmore, D.Sc. (Egham) and C. W. Lloyd-Jones (Secunderabad); George Stephenson Gold Medals to Messrs. G. A. Hobson (London) and W. C. Copperthwaite (London); Telford Premiums to Messrs. C. F. Jenkin, B.A. (London), W. A. P. Tait, B.Sc. (Edinburgh), A. P. Trotter, B.A. (London), M. Kellow (Penrhyndeudraeth), H. J. S. Heather, B.A. (Johannesburg), A. M. Robeson (Johannesburg), and J. W. Kitchin (Bristol); a Crampton Prize to Mr. R. F. Thorp (London); Manby Prizes to Messrs. S. A. Frech (London) and G. D. McGlashan (Blyth); the Miller Scholarship and the "James Forrest" Medal to Mr. A. C. Anderson (Wolverhampton); Miller Prizes to Messrs. R. A. Whitson (Basutoland), C. A. Ablett, B.Sc. (Addiscombe), E. H. Heathcote, M.A. (Henbury, near Macclesfield), G. B. G. Hull (Stockport), H. Stringer (Stoke-on-Trent), G. F. Walton (Edenfield, near Manchester) and A. T. West, M.Sc. (Woolwich); Bayliss Prizes, awarded on the results of the October and February examinations, 1906-7, respectively to Messrs. F. C. R. H. Boyd (Luxor, Upper Egypt) and D. J. Morris (Swansea).

American Society of Mechanical Engineers.—The fifty-fourth annual meeting of the Society will be held in the Engineering Societies' Building at 29, West 39th Street, New York, December 3rd—6th, 1907. Symposiums on foundry practice, giving the experiences of prominent men in that work, have been arranged. The specific heat of superheated steam will be taken up, and a very important and exhaustive work by a Professor of Engineering at Cornell will be presented. The utilisation of low-grade fuels in gas producers, combustion control in gas engines, tests of producer-gas engines, &c., will be given a session, and other live topics, such as industrial education, power transmission by friction driving cylinder port velocities, &c, will be discussed. All of these subjects have been treated by prominent engineers of Europe and America and men eminent in the particular work of which they write.

Electricity in Australian Mines.—The *Australian Mining Standard* for October 25th says:—"The important question as to the probable danger or otherwise of the use of electricity in coal mines—electricity for driving coal cutters—was brought under the notice of the Minister for Mines, New South Wales (Mr. S. W. Moore), last week, by a deputation of representatives of the Northern and Southern District Colliery employés. It was pointed out to the Minister that there were urgent reasons for an investigation into the matter by a Royal Commission. About 400 men were idle at the Hebburn colliery because of the fear that an accident might happen by sparks emitted from the electric cables coming in contact with the gas in the mine. The deputation stated that it could be proved that sparks were emitted nearly every day from the machines, and they had been informed that the machines had been condemned in several mines, including one in New South Wales. The Minister, in reply, agreed that the matter was of very great importance, as shown by the report of a committee appointed in the old country. A paragraph from that report, which had impressed him, was to the effect that electricity was bound to play a very large part in mining in the future, and every possible information in regard to it should be obtained. If it were improperly used accidents might result, but if properly used there appeared to be no suggestion of danger. The Minister promised that in view of the reasonableness of the request, and the great importance of the matter, a full, searching and complete inquiry would be held into the whole question of electricity in any shape or form in gaseous mines."

Exhibition at Acton.—The Acton U.D.C. is to hold an electrical exhibition from January 18th to 25th, and invites probable exhibitors to apply to Mr. J. Martin Blair, the electrical engineer. A notice concerning the matter appears in an advertisement to-day.

A Fog Load.—We have received from Mr. S. E. Fedden, general manager and engineer of the Sheffield electricity department, the accompanying maximum load chart recorded on



Monday, October 28th. This is of interest as showing that the day-load during a fog is practically equal to the evening lighting peak. The fog in question was not a particularly black one, but was evenly distributed over the city.

Cape Criticism of Electrical Fittings.—According to our contemporary, the *British South African Export Gazette*, the lengthy and detailed instructions for the prevention of accidents in connection with electrical installations recently issued by the Cape Government appear likely to have a serious effect on the demand for a certain class of domestic fitting. "The instructions chiefly deal with street accidents due to broken trolley wires, but there is a short section drawing attention to dangers connected with the use of electric light in bathrooms, and a special warning is given against the use of switches with brass covers and knobs, lamp-holders (known as key-holders), key switches, metal casing for wires and flexible suspension cords. Brass knobs and covers and lamp-holders are objected to *in toto*, while it is advised that the other fittings referred to should be placed out of reach. No doubt a bathroom, with its damp floor, &c., offers a certain special danger of inadvertent shocks being administered, but the average fitting in use in the Colonies, even when mounted with brass, is not so badly constructed as to create risks, and the elaborate warning issued by the Government seems somewhat unnecessary. Indeed, its principal effect seems likely to be that of unnecessarily alarming the public about very remote dangers, and of creating a prejudice against the domestic use of electric light, for the majority of people will not concern themselves with the distinction drawn between a bathroom and other apartments. Meanwhile, however, there will probably be a special demand in the Cape Colony for wood and porcelain fittings at the expense of the trade in metal goods."

Warning.—"Charity" asks us to make it known that a man who professes to be a representative of a well-known firm of contractors is adopting curious methods of borrowing money. He tells a good tale accounting for the emergency of his requirements, and makes every endeavour and excuse to get out of repaying. Should it happen that among our readers there are other manufacturers' representatives who are being treated in the same way, "Charity" (c/o Electrical Review) will be glad if they will communicate with him.

Poor Law Institution Machinery and Engineering.—The Local Government Board has appointed a departmental committee to inquire and report on the subject of the Machinery and Engineering Staff at Poor Law Institutions. The *Times* states that the committee consists of Mr. A. B. Lowry, chairman, Mr. B. T. Kitchin, and Mr. H. R. Hooper, with Mr. I. G. Gibbon as secretary.

Electricity Licences in India.—*Indian Engineering* believes that one of the most important recommendations of the Committee appointed recently to report on the question of amending the Act of 1903 is that the administration of the Act should be entirely in the hands of the Government of India, and that all licences should be granted by the latter authority. "The present system is most unsatisfactory as far as the mercantile community are concerned. A company applies for a licence to one local Government on the model of a licence previously granted by another local Government to the same firm, and is somewhat surprised to learn from the former that it cannot agree to the proposed terms of the licence; and a revised licence has to be drawn up, resulting in intolerable delay and sometimes in financial loss. Centralisation would, therefore, be a blessing in the matter of the grant of licences, and we believe that it would be welcomed by all concerned."

Copper.—The general position and prospects of copper production at the present time are treated of in an article by Mr. James Douglas, appearing in the October issue of the *Engineering Magazine*, entitled "The Copper Situation in the United States." The production of various countries, given in tabular form, at once shows the enormous superiority of this division of the American Continent over the rest of the world in copper output, and it is, therefore, evident that the copper position of the States is practically that of the world. Mr. Douglas commences by commenting on the recent high prices which, as he points out, have been in a certain sense fictitious, not reaching the producer, who had already contracted to supply the large consumers, or what may be termed the "storage" companies, for a certain period. This would lead to the inference that the intermediate dealers, finding the demand either in excess of their anticipation or, as seems more probable, concentrated on a short period, held their stocks to enhance the price until, the immediate wants of the customers being satisfied and the price at the same time becoming prohibitive, the buyer withdrew from the market leaving large stocks still undisposed of.

Referring to sharp rises in demand, the author remarks: "While such spasmodic variations are transitory there can be no doubt that, if the demand grows and no very important new discoveries are made, the metal will become scarcer and will command a higher price than the average price of the past. One consequence, which will also be a corrective, will be that the metal will cease to be used for purposes to which it is turned to-day, and for which a cheaper material can be discovered." He also points out that continued high prices result in the working of poorer ores at a profit, and a consequent increase of total production. Of the production of different countries some very interesting tables are given. The United Kingdom produced in the five years ending 1905 about one-seventh of the quantity for the period 1881-5. Spain and Portugal show a decrease of 8 per cent. for the period 1901-5, as against 1·96-1900. Norway, it is interesting to note, attained 25,575 tons for 1901-5, an increase of nearly 50 per cent. on the preceding quinquennial total. The other minor producers who are on the increasing side are Russia, Japan, Peru and Canada.

The figures are lead by those of the United States, 1,600,000 tons for the five years. Spain and Portugal come next with 245,000 tons, a decrease for the period 1901-5 as against the output for 1896-1900. Australasia is credited with 159,235 tons, against for the preceding five years 89,770; Japan, 159,370; Germany, 107,735, and Mexico, 227,660 tons. Germany shows a steady increase, Japan and Australia increase in larger quantities, and Mexico has risen sharply.

In the author's opinion Chile, Bolivia and Peru will show an increase in the future, especially in view of the utilisation of poorer ores. It is probable that the output of Peru is capable of considerable expansion, the lack of transport facilities being at present the difficulty. In Africa, the Tanganyika Concessions, Ltd., claims to have discovered regions in the Congo Free State and Rhodesia rich in copper. Here, again, development is dependent on potential railway construction. Japan's growing output is liable to be absorbed by increasing home demand. Mr. Douglas comments: "A review, therefore, of the world's mines would seem to indicate that the old mines are approaching exhaustion, that no new large deposits of rich ore, except probably those of Tanganyika, are in sight; and, therefore, the trade must turn to deposits of lower grade than have heretofore been worked, if the demand continues as active as at present." He also points out that, in many commercial uses, the copper worn off is practically entirely lost, as, for instance, in overhead trolley work, the loss on which he estimates as 5,000 tons per annum on the electric railways of the United States. He remarks on the increased use of copper for ornamentation in building work, a condition which does not seem to apply in this country to the same extent.

Messrs. Morton's circular reviewing the statistical situation up to October 31st shows distinct improvement in price and slight increase in visible supplies (12,728 tons, against 12,138 tons end of September). Australia shows a marked increase in shipments (4,500 tons, against an average of about 3,600), and the quantity from North America is also high, which may be attributed to a policy of equalising stocks. The cheerful tone of the circular does not seem to have been maintained by the market, the price being down again to the neighbourhood of £64 at the time of writing.

British Manufacturers Beaten Again — by the "Daily Mail."—The *Daily Mail* for Monday last published a note received from its New York correspondent that Westinghouse interests "in competition with British Government contractors," had "secured the contract for the electrification of Devonport Dockyard." "Among other features of the installation will be *huge* electric motors operating the largest shipbuilding crane in the world." This item would have come a little nearer to being correct had it been also stated that the contract for the whole of the electrical generating plant, sub-station equipment and outside lighting for the Dockyard was placed in the hands of Messrs. Crompton and Co., Ltd., some time ago, and that the work is actually finished.

The British Westinghouse Co. has an order for some motors for the Dockyard. On page 659 of our October 18th issue we gave particulars of the crane equipments, which are to be supplied by Messrs. Cowans, Sheldon & Co., Ltd., of Carlisle. The large crane of 160 tons is there briefly particularised, and mention is made of the fact that the motors for the main lifting, light lifting, traversing and revolving motions are to be of the Westinghouse type. Are these the *Daily Mail's huge* motors?

The daily Press of this country depends upon its New York correspondent for incorrect information concerning a British electrical contract, when the correct information has already been made known in this country weeks before!

Our daily papers would do something to help British industry and to lead their readers instead of misleading them, if they would devote an occasional column of paragraphs to what British manufacturers are doing. They would then not be in such danger of letting incorrect news concerning British trade decadence obtain publicity.

Appointments Vacant.—The Indian Institute of Science, Bangalore, is about to make an appointment to the Chair of Electrical Technology (£1,000 and residence). Candidates should send their names to the director of the Institute, care of the Secretary of the Royal Society, Burlington House, W.C.; assistant foreman for overhead line for Blackburn tramways (30s.); chief assistant electrical engineer for Hoylake and West Kirby U.D.C. (£125).

Large Gas Engines.—In a circular letter to the technical Press, Mr. E. J. Fox, of Victoria Works, Rugby, challenges the data recently given by Mr. Leonard Andrews for the running costs of gas engines and steam turbines respectively, on the ground that they unduly favour the former. The capital cost of the turbine, he says, is too high, and the allowance of 10 per cent. for interest and depreciation should be raised to 15 per cent., when the turbine would show to much better advantage. The Johannesburg troubles are cited in answer to the claims now made for large gas engines, which, in many cases, Mr. Fox considers, are extravagant.

In a reply received from Mr. Andrews after our "Correspondence" columns were closed, Mr. Fox is invited to put forward definite figures; those advanced by Mr. Andrews were based upon actual steam turbine installations, and were, if anything, too favourable to the latter.

Rochdale Stokers.—On page 259 of our issue of August 16th, through an error on the part of Messrs. E. Bennis and Co.'s publicity department, it was stated that that firm were carrying out an "extension to *eight* Bennis stokers and furnaces already working there." We are asked to state that this should have read *six*.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—MR. WALTER PETTY, of the British Westinghouse Co., Ltd., has secured an appointment as shift engineer on the L.C.C. Tramways.

MR. F. WILLIAMS, chief assistant engineer to the Leek U.D.C., has, after four years' service, resigned his appointment in order to join the staff of British Insulated and Helsby Cables, Ltd., and MR. A. HEMMING, of Leek, has been appointed to fill the vacancy. On the 15th ult. Mr. Williams was presented with a brown leather dressing case by Mr. R. M. Carr, the chief engineer.

MR. E. E. HAMAR, late shift engineer at the municipal electricity works at Gillingham, Kent, has been presented with a token of respect from the staff, on his leaving to take up an appointment as shift engineer to the Kent Electric Power Co.

Tramway Officials.—MR. E. S. MOULDEN, who was for several years with Messrs. J. H. Holmes & Co., Newcastle-on-Tyne, has been appointed chief assistant engineer to the Municipal Tramways Trust, Adelaide, S.A.

General.—The *Times* states that SIR OLIVER LODGE has accepted the invitation of the Council to succeed the late Sir William Perkin in the presidency of the Faraday Society.

The *Times* also says that Principal E. H. GRIFFITHS, of the University College of South Wales and Monmouthshire, Cardiff, has been awarded the Hughes medal of the Royal Society for distinguished services in testing the validity of electrical units by determination (assuming that validity) of the mechanical equivalent of heat.

MR. WILLIAM T. TAYLOR, M.I.E.E., late superintendent and chief engineer, Cia. Industrial Mexicana, Chihuahua, Mexico, has resigned his position. Mr. Taylor came to England two months ago on a vacation, returning to America on the R.M.S. *St. Paul*, October 12th. We learn that he is about to return to England (November 5th, on the ss. *Carmania*), and that his location will be Kashmir, India. We are informed that a patent was recently

granted to Mr. Taylor for an invention of polyphase distribution from which it is possible to connect three-phase and two-phase apparatus without employing transformers, or without running two independent systems, as is the usual practice to-day.

Mr R. W. Sutherland, of Cleckheaton, Yorks, who—with Mr. E. S. Moulden—spent a considerable time in the U.S.A., has left by the R.M.S. *Moldavia* to take up his duties as managing engineer to Messrs. Todd & Samuel, of Adelaide, S.A.

The Swansea staff of the National Telephone Co. has presented a gold mounted umbrella to Mr. A. G. Mackie, district manager, who is leaving to take up a similar position at Ipswich.

CITY NOTES.

Drake & Gorham, Ltd.

The directors' report for the year ended June 30th, 1907, states that after payment of all charges, including bonuses due to staff, there remains a net profit of £343, which, with the sum of £1,056 brought forward from the previous year, makes a total of £1,399, which it is proposed to carry forward. The directors regret that the result of the year's working will not justify the payment of a dividend, which must be attributed to general stagnation in electrical business, high cost of materials, and low prices obtainable, especially in the South of England. Owing to the condition of the financial markets there has been a general desire on the part of those on whom the company relies for country-house lighting to defer outlay on luxuries, and a reduction in turnover and profits in this department has resulted. The expense involved in the transfer of stock to the new stores has been written off; obsolete apparatus has been depreciated, and provision has been made for a difference in the stock, which has no doubt been occasioned by the change of premises, both for fittings and works. The work at the branches has been satisfactory, especially in Manchester where the business has increased. A demonstration of the electrically-driven cotton mill was given to a number of mill-owners, from which orders may be anticipated. The building and electrical equipment of the lace mill mentioned in the last report has been completed, and the results obtained have fully answered expectations. Other mills are in hand, also a woollen factory, and the electric driving of a portion of a weaving mill is nearly completed. The company has extended its business as purchasing agents and experts for motor-cars, and a number of letters have been received showing appreciation of the services rendered. Since the commencement of the financial year several satisfactory orders have been received, and economies are being effected where possible, so that if the financial conditions of the country improve, it is hoped that the company will during the present year resume its normal condition.

[The result of the previous year's business was:—Net profit, £7,511, plus £2,044 brought forward. Dividend, 6 per cent. per annum; reserve, £1,000; carrying forward £1,056.]

The Paris Popp Co.

The interesting announcement is made that the Compagnie Parisienne de l'Air Comprimé et d'Electricité—the so-called Popp Co.—intends to pay a dividend of 6½ per cent. for the year ended June 30th, 1907. This will be the first distribution ever made by this French company, which was formed in the eighties of the last century, with very sanguine expectations as to the future by means of a combination of the supply of electricity and of compressed air, according to the Popp patents, in one of the most favourable districts of Paris. But these anticipations were never realised, and in recent years the compressed air branch has merely represented an insignificant part of the company's business. German investors participated in the foundation of the undertaking, which was able in 1905 to pay off the remaining debt of £200,000 owing to a Berlin company. The fact that the Paris company has improved its position is due to the possession of the concession for the supply of one of the most important parts of Paris. This concession, and those held by the other electric lighting companies, have been prolonged until 1913, when a new company, in which all existing companies have become interested, will undertake the lighting of Paris under the new agreement with the municipal authorities until the year 1940.

Cape Electric Tramways, Ltd.

In their report for the year ending June 30th, 1907, the directors present a profit and loss account showing, after providing the debenture interest and redemption of debentures, a net balance to credit of £14,715, which, added to the balance of £1,751 brought forward from last year, gives a total balance of £16,466. From this sum the reserve fund has been credited with the amount of £4,000, and the balance, £12,466, has been carried forward. During the year under review, the tramways carried in Cape Town 12,563,303 passengers, earning £131,594, against 12,377,310 passengers, earning £147,715 10s. during the year 1905-6. In Port Elizabeth, during the year under review, 3,676,035 passengers were carried, earning £39,696, against 3,905,536 passengers, earning £42,857 for the year 1905-6.

From the foregoing figures it will be seen that the business of the company has fallen off on nearly all sections owing to the continued depression, which has had the effect of decreasing the commerce and population of Cape Town; the necessity for reducing the fares on certain sections of the system has also contributed to the diminution of the revenue. The arbitration between the Cape Government and this company, in regard to the amount to be paid by that Government to this company as compensation for the expropriation of the Sea Point Railway, took place during the year, and the amount of the award, £41,200, has been duly paid to this company by the Government. The competition of the Sea Point Railway with the tramways has continued during the year under review, and has become more acute as the railway rates have been still further lowered, and in self-defence this company has had to do likewise. The most marked decrease in receipts is on the Sea Point section of the company's Cape tramway system, and is, of course, directly owing to the unfair competition instituted under the ægis of the Cape Government.

Every effort has been made by the directors to bring about a settlement, and the Cape Ministry were appealed to to induce the Sea Point Municipality to agree to a reasonable compromise. Unfortunately, the concessions which the directors were willing to make (which were acknowledged as reasonable by the Prime Minister and Commissioner of Crown Lands and Public Works of the Cape Colony) were rejected by the Sea Point Municipality. In face, however, of the adverse conditions prevalent during the year under review, the general manager at Cape Town continued to make further retrenchments in every department compatable with retaining efficiency, and as a result the working expenses for the year ending June 30th last show a reduction on the previous year of over £16,000 for the Cape Town system. In Port Elizabeth, also, the general manager there has decreased the working expenditure of that system by £1,600 for the past year as compared with the previous year. The directors have every reason to be satisfied with the excellence of the local administration, and especially with the general managers at Cape Town and Port Elizabeth, who have done their utmost to protect the interests of the company under great difficulties.

Richardsons, Westgarth & Co., Ltd.

Sir Christopher Furness, M.P., in his address at the annual meeting held on October 31st, stated that the turbine works at Hartlepool were making rapid progress. They were just completing an entire generating plant at Spennymoor for the Durham Electric Power Supply Co., consisting of four turbines with Contraflo condensers, cooling towers, Nesdrum boilers—in fact, they were to hand over the plant complete in full working order. The station adjoins the Weardale Co.'s works, and would utilise the gas produced from that company's coke ovens, which were now being erected. These ovens were capable of producing some 3,000 to 4,000 tons of coke per week, and the plant represents the latest developments in coke production. Amongst the turbines in progress were those for the Corporations of Dublin and Glasgow, and one of 12,000 H.P. for the Dunston power station of the County of Durham Electric Power Supply Co., this turbine being the most powerful yet made for any electric power station in the kingdom. With regard to the future, it was impossible to forecast what would happen, but he was confident that they would not only get their full share of orders, but that their profits would be at least as favourable as the average prevailing in their range of manufactures.

British Columbia Electric Railway Co., Ltd.

The directors' report for the year ended June 30th states that the business shows continued and increasing prosperity in all departments, and a further increase in dividend is recommended, which will place the deferred ordinary stock on an 8 per cent. basis, and, consequently, the preferred ordinary stock on a 6 per cent. basis. The gross receipts show an increase over those of the preceding year of $329,204, and the net earnings, including income from investments in subsidiaries, after charging renewals, show an increase of $186,251. The following charges have been made against the revenue account:—Provision for renewals maintenance (from which £8,568 has been deducted for adjustments and expenditure on renewals), £26,161; bonus to employés, £5,702; amount added to capital amortisation fund, £1,866. The net profit for the year, after making these deductions, amount to £105,013, plus £2,619 brought forward. There are deducted:—Debenture interest, £23,775; interim dividends on 5 per cent. cum. per. pref. stock for six months to December 31st, 1906, £7,500; on preferred ordinary stock for nine months to March 31st, 1907, £11,250; and on deferred ordinary stock for six months to December 31st, 1906, £14,000; leaving available for distribution and reserves, £51,107. From this the directors have decided to transfer to reserve fund £18,876; dividend on the cum. per. pref. stock for six months to June 30th, 1907, £7,500; dividend on the preferred ordinary stock, 5 per cent. per annum for three months to June 30th, 1907, £3,750; additional dividend on the preferred ordinary stock 1 per cent. per annum for the six months to June 30th, 1907, £1,500*; dividend on the deferred ordinary stock at the rate of 8 per cent. per annum for the six months to June 30th, 1907, making 7½ per cent. for the year, £16,000; carrying forward, £3,481. The reserve fund has also been credited with the sum of £4,124, being the estimated value of certain bonus lands in North

* The preferred ordinary stock is entitled to participate rateably with the deferred ordinary stock in profits distributed as dividends after the deferred ordinary stock has received a dividend of 7 per cent., and, consequently, the preferred ordinary stock will receive an extra dividend for the six months ended June 30th, 1907, at the rate of 1 per cent. per annum, which will be paid with the next half-yearly dividend on November 30th.

Vancouver now being utilised by the company. The number of lights in use at June 30th, 1907, was 216,786, an increase of 49,456 over the number in use on June 30th, 1906. The number of passengers carried during the year was 16,281,766, an increase of 3,886,184. During the year £140,855 has been spent in extensions and improvement of the company's property and equipment. The North Vancouver extension is now in active operation, and there is every indication that it will prove a valuable adjunct to the company's system. The Vancouver power installation continues to work satisfactorily. To meet increased demands, an additional unit is now being installed, which will bring up the capacity of the plant to 22,000 H.P. Further extensions and improvements have been made in the plant and equipment of the Vancouver and Victoria Gas Companies with satisfactory results. The Hon. M. R. Gifford is now in British Columbia on a visit of inspection, and arrangements have been made for the managing director to proceed there in the spring. The directors record their appreciation of the services of the company's general manager, Mr. R. H. Sperling, and the staff in British Columbia, and their satisfaction with the excellent relations which continue to exist between the company and its employés. An agreement has recently been made with the employés settling a revised wages schedule for the next three years. The share of profits for the past year distributed among the employés amounts to $27,342. During the year an issue of £300,000 4½ per cent. perpetual consolidated debenture stock has been made in order to provide funds for the company's general requirements, and, in particular, for the construction of a new line from New Westminster to Chilliwack, a distance of 60 miles. Construction work on the Chilliwack line has now been commenced.

Electrolytic Alkali Co., Ltd.

The annual meeting of this company was held in Liverpool on November 4th.

Colonel W. L. Pilkington, who presided, in moving the adoption of the report (see Electrical Review, November 1st, p. 741) said, according to the *Financial Times*, that as a result of experience the directors were of opinion that the company had suffered materially in consequence of too much information being made public, and that it was not in the interests of the company to present the accounts in such detail as hitherto. The directors had no object in withholding details except that of protecting the company's interests. The board was naturally disappointed that it was not in a position to present an account showing a net trading result at least equal to that of last year. It hoped it was only a postponement of the time when the company would be able to make a return to all the shareholders on their investments. The directors' great regret was that they were not sharing in the present trade boom, more especially as some portions of the chemical trade were benefiting. Two and a-half years' dividend had now accrued on the preference capital, but in view of the unsettled state in that portion of the chemical trade in which they were engaged, the board thought the wisest course was to pay only one half-year's dividend upon such shares.

The report was adopted.

West India and Panama Telegraph Co., Ltd.

The directors' report for the half-year ended June 30th, states that the amount to credit of revenue is £43,833, against £36,999 for the corresponding half-year of 1906, and the expenses have been £30,029, against £25,681. The result of the half-year's working, therefore, leaves a balance of £13,804, to which is added £1,621 interest on investments, and £627 brought forward, making an available total of £16,052. The directors propose that this amount be dealt with as follows:—First preference shares—dividend 6s. per share, six months to June 30th, £10,369; second preference shares—payment of £1 per share on account of dividends accrued of June 30th, 1907, £4,669; balance to current half-year's account, £1,014. The board have much satisfaction in being able to recommend the above payment to the second preference shareholders on account of dividends which have been accruing since June 30th, 1900. The traffic receipts for the six months show an increase of £4,489, as compared with the corresponding period of 1906. The expenses of repairing cables, including the cost of restoring communication between Dominica and St. Lucia, referred to in the last report, amount to £13,787. The cables continue in good working order.

Malacca Rubber Plantations, Ltd.

The meeting of this company was held on October 30th, Mr. G. B. Dodwell presiding. The first annual report to December 31st showed that the company now owned about 13,150 acres of land, of which over 6,000 acres was under rubber. The rate of growth of the Para trees was slow as compared with the results obtained in low-lying country, and this delayed the period at which tapping became advisable. The net profit for the year was £3,840. The deficiency in the preference dividend has been made good out of the guarantee fund deposited for the purpose, and will be repayable to the guarantor, with interest, out of future profits in excess of 10 per cent. on the nominal capital. The Chairman said that they expected to have, by December 31st, about 6,600 acres under rubber. They thought that a conservative estimate should give them a million trees. The rubber produced during the few months in 1906 that tapping was proceeded with, amounted to about 14,500 lb. Para from about 30,000 trees, and about 1,500 lb. Rambong from about 5,000 trees. The average prices obtained were: For Para "crêpe" No. 1, 5s. 5d.; Nos. 2 and 3, 4s. 11d.; and for Rambong, 4s. 2d. Tapping was stopped at the end of October until the trees had reached maturity and until the more efficient labour was available. Since August 1st tapping had been resumed on a small scale, and they expected that this would be continued with gradually increasing results.

Eastern Extension, Australasia and China Telegraph Co., Ltd.—The report for the half-year ended June 30th states that the gross receipts amounted to £304,367, against £303,791. The working expenses, including £25,704 for maintenance of cables, absorb £155,930, against £141,246 for the corresponding period of 1906, leaving £148,437. The net profit for the half-year is £132,603, plus £17,344 brought forward. Two quarterly interim dividends of 1½ per cent. each have been paid for the half-year, leaving £75,947 to be carried forward. The general reserve fund has been debited with £120,000 as a provision on account of investment fluctuations, and this sum has been deducted from the cost of investments.

Eastern Telegraph Co., Ltd.—The report for the half-year ended June 30th last states that the revenue amounted to £593,432, and the available balance is £351,128. After paying income-tax, debenture interest, preference dividends and placing £7,000 to the reserve fund for maintenance of ships, £120,000 to the general reserve fund, the directors have allocated £100,000 to meet the two interim dividends of 1½ per cent. each on the ordinary stock, leaving a balance of £41,651 to be carried forward. The general reserve fund has been debited with £130,000 as a provision on account of investment fluctuations, and this sum has been deducted from the cost of investments. Mr. J. C. Denison-Pender has been appointed to a seat on the board.

Castner-Kellner Alkali Co., Ltd.—The directors have declared a further dividend at the rate of 16 per cent. per annum, making a total distribution of 12 per cent. for the year ended September 30th.

West African Telegraph Co.—The directors announce an interim dividend at the rate of 4 per cent. per annum for the half-year ended June 30th.

Official Announcements re Companies.—The following companies have been struck off the register:—

Herculite and Electrical Manufacturing Co., Ltd.
Printing Telegraph and Construction Co. of the Agence Havas, Ltd. (Registered January 18th, 1903).

The following will be struck off the register within three months unless cause is shown to the contrary:—

Advance Boiler Co., Ltd.
British Steam Generator and Refuse Utilisation Co., Ltd.
Direct-Automatic Stoker Syndicate, Ltd.
Electric Exploitation Co., Ltd.
J. G. Statter & Co., Ltd. (Registered December 21st, 1893).
Orme's Electric Signal Syndicate, Ltd.
Telephone Press, Ltd.

Stock Exchange Notices.—The Committee has ordered the undermentioned securities to be quoted in the Official List:—

Kent Electric Power Co.—£75,000 4½ per cent. irredeemable debenture stock.

Applications have been made to the Committee to allow the following securities to be quoted in the Official List:—

British Electric Traction Co., Ltd.—Further issue of £118,758 4½ per cent. second debenture stock.
Shawinigan Water and Power Co.—$6,500,000 capital stock in shares of $100 each.

London Platino-Brazilian Telegraph Co., Ltd.—An interim dividend of 1½ per cent. on account of the year to December 31st has been declared.

St. James's and Pall Mall Electric Light Co.—A financial paper says that the amount of electricity sold for the nine months ended September 30th, 1907, is returned at 6,193,750 units, estimated to produce £79,943, as against 5,468,373 units, which produced £73,430, for the corresponding period of last year.

Prospectuses.—*The London Asiatic Rubber and Produce Co., Ltd.*—The subscription list of this company for an issue of 107,000 shares of £1 each was open this week, from Monday to Wednesday. The company has about 650,000 rubber trees planted on its estates in the Malay Peninsula.

Canadian General Electric Co.—It is stated that the issue of 7 per cent. preference stock was considerably over-applied for in London alone.

City of Buenos Ayres Tramways Co. (1904), Ltd.—A dividend of 1s. 3d. per share, less tax, has been declared for the quarter ended September 30th.

France.—La Société d'Eclairage Electrique du Secteur de la Place Clichy, of Paris, reports a net profit of £28,196 for the past financial year, as compared with £28,602 in the preceding 12 months. A dividend of 45 francs per share is being declared.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open.	Inc.
Aberdeen	Oct. 30	2,523	+ 63	22	33,284	— 1,422	14·4	..
Ayr	Nov. 2	377	+ 6	25	9,266	— 193	8	..
Bath	Oct. 30	1,377	— 101	44	35,377	— 1,596	13	..
Belfast	Nov. 1	7,254	+ 536	31	115,197	+ 7,750	36	..
Birkenhead	,, 3	2,195	+ 205	30	33,442	— 260	13·52	..
Birmingham Corp.	,, 2	12,626	..	31	139,901	..	56·46	..
†Blackburn	Oct. 30	2,174	+ 250	31½	35,841	+ 2,235	14·12	..
Blackpool Corp.	,, 31	989	+ 127	..	44,911	— 1,400	11·87	..
,, —Fleetw'd.	Nov. 2	587	+ 65	17	21,345	— 1,105	6·25	..
Bolton	,, 3	4,433	+ 358	31	71,960	+ 4,800	26	..
Bournemouth	Oct. 30	2,899	— 61	30½	56,666	+ 907	21·5	2½
Bradford	Nov. 2	8,864	+ 429	31	147,092	+ 2,579	54	1
Brighton	,, 3	1,574	— 27	31	30,696	— 2,892	9·5	..
Bristol	,, 1	9,861	+ 80	..	..	..	28·5	..
Brit. Elec. Trac. Co.								
Airdrie	Oct. 25	492	+ 35	42	9,504	— 30	3·65	..
Barnsley	,, 25	334	+ 15	,,	7,130	+ 111	..	..
Barrow	,, 25	488	+ 21	,,	11,104	— 2·2	5·87	..
Cavehill	,, 25	141	+ 26	,,	3,708	— 2·3	..	..
Devonport	,, 25	856	— 68	,,	19,674	— 263	8·85	..
Gateshead	,, 25	2,038	+ 102	,,	42,797	+ 1,065	11·25	..
Gravesend	,, 25	475	+ 13	,,	10,571	— 31	6·5	..
Greenock	,, 25	1,240	+ 131	,,	28,298	— 757	7·25	..
Hartlepool	,, 25	534	+ 5	,,	12,510	— 633	6·72	..
Kidderminster	,, 25	204	+ 11	,,	5,214	— 115	..	..
Leamington	,, 25	283	+ 35	,,	7,039	— 647	3	..
Merthyr	,, 25	418	+ 9	,,	8,963	+ 440	2·9	..
Metropolitan	,, 25	9,493	+2,463	,,	193,260	+50,329	22	..
Middleton	,, 25	670	+ 45	,,	15,227	— 169	8·5	..
Mid. Joint Com'tee	,, 25	11,887	+ 185	,,	248,814	+ 3,621	..	..
Oldham—Ashton	,, 25	1,217	+ 55	,,	25,864	+ 1,186	9·13	..
Peterborough	,, 25	250	+ 28	,,	5,540	— 197	5·31	..
Potteries	,, 25	3,952	+ 52	,,	79,793	+ 2,218	29	..
Rothesay	,, 25	111	+ 6	,,	10,031	— 557	2·75	..
Southport	,, 25	467	— 34	,,	13,112	— 651	8·17	..
S. Metropolitan	,, 25	1,604	+ 717	,,	34,852	..	..	..
Swansea	,, 25	1,814	+ 132	,,	39,475	+ 2,910	5·5	..
Tynemouth	,, 25	355	+ 15	,,	10,892	— 721	3·75	..
Weston-s-Mare	,, 23	122	+ 12	,,	6,835	— 379	3	..
Worcester	,, 25	597	+ 1	,,	12,277	— 198	5·75	..
Wrexham	,, 25	207	— 1	,,	4,414	— 82	..	..
Yorks. Wool. Dist.	,, 25	1,763	— 100	,,	39,942	+ 800	17	..
Miscellaneous	,, 25	416	— 1	,,	9,630	— 190	..	..
Burnley	Nov. 2	2,444	+ 142	..	..	..	7·5	..
Burton-on-Trent	,, 2	533	— 4	31	9,208	— 424	11	2
Bury	Oct. 27	2,168	..	30	34,223	..	10·5	..
†Cardiff	,, 26	2,028	+ 65	30	66,501	+ 1,785	15·87	..
Carlisle	Nov. 2	341	— 15	44	7,740	— 548	..	..
Chatham and Dist.	Oct. 31	1,324	— 93	44	31,973	+ 1,282	12·16	·68
Cork	,, 31	844	— 32	44	20,653	— 829	9·89	..
Croydon	Nov. 1	2,707	— 25	31	45,351	+ 2,023	12	·75
Darlington	,, 2	425	+ 5	31	6,671	— 51	..	..
Darwen	,, 1	513	+ 18	31	8,063	— 19	4·36	..
Dover	,, 2	399	— 36	31	7,687	— 1,023	4·75	..
Dublin	,, 1	11,884	+2,493	..	127,654	+29,149	54·25	5·5
Dundee	Oct. 30	2,222	+ 90	24	27,977	+ 719	13	..
East Ham	Nov. 2	1,742	+ 61	31	28,901	— 202	7·75	..
Exeter	Oct. 18	571	— 30	29	9,757	+ 656	4·75	·5
Glasgow	Nov. 2	33,766	+1,657	22	393,358	+10,578	89·75	8
Hastings	Oct. 31	1,790	..	..	..	..	..	..
Huddersfield	Nov. 2	3,096	+ 233	31	50,475	+ 2,381	28	..
Hull	,, 2	4,959	+ 300	31	73,807	+ 3,941	13	..
Ilkeston	Oct. 30	308	+ 18	31	4,584	+ 949	3·5	..
Ipswich	Nov. 2	690	— 47	31	13,399	— 1,001	10·5	..
Isle of Thanet	,, 2	702	+ 91	44	30,125	— 371	11	..
Kilmarnock	,, 2	301	— 6	24	3,991	— 104	4·25	..
Lan'kshire Trm Co.	Oct. 31	2,764	+ 853	44	52,777	+13,690	15·82	3·96
Lancashire United	,, 30	2,451	+ 342	44	56,109	+13,220	39	1
†Leeds	,, 31	6,314	+ 100	30	199,620	+ 8,300	51·13	..
Leicester	Nov. 2	4,169	— 4	..	..	..	..	..
Leith	,, 2	1,027	+ 30	24½	13,406	+ 40	6	..
Liverpool	Oct. 26	21,696	— 126	43	471,311	+ 7,429	104	..
†L.C.C.	,, 26	63,672	+10,442	30	947,491	+155,813	116·5	10
London United	Nov. 1	11,880	+ 444	..	289,236	+12,137	..	..
†Lowestoft	,, 2	341	— 14	5	929	— 45	3·5	..
Manchester	,, 2	29,902	+2,137	31	466,745	+33,854	86	11
Newcastle	,, 2	8,374	+ 355	31	128,186	— 587	..	..
Newport	,, 2	1,263	+ 24	31	21,997	+ 1,709	14·5	..
Northampton	,, 1	800	+ 13	30½	13,862	— 501	5·5	..
Oldham	,, 3	3 832	+ 274	32	62,986	+ 8,942	28·75	..
Pontypridd	,, 2	548	+ 230	31	8,349	+ 3,044	5	1·75
Portsmouth	,, 2	8,405	+ 188	31	65,867	— 1,893	14·5	..
Preston	Oct. 30	1,438	+ 27	..	..	..	..	..
Reading	,, 31	1,211	+ 16	30½	19,589	— 728	13·25	..
Rotherham	,, 31	1,192	+ 193	30½	18,787	+ 3,022	10	·66
Salford	Nov. 4	9,126	+ 327	31	147,421	+ 4 059	33·9	..
Sheffield	,, 3	11,178	+ 892	32	178,983	+ 8,302	35·75	..
Southampton	Oct. 30	2,035	+ 231	30	32,659	+ 1,496	..	..
Southend-on-Sea	,, 20	624	+ 43	31	14,119	— 86	..	..
Sunderland	,, 6	2,624	— 126	27	89,342	— 550	..	..
Swindon	,, 30	318	— 5	..	..	..	4·4	..
Tyneside	,, 30	986	+ 102	44	30 572	+ 836	9·87	..
Wallasey	Nov. 2	1,524	+ 84	31	27,186	+ 725	8·72	·22
Walthamstow	,, 2	1,088	+ 91	31	20,035	+ 233	9	..
West Ham	Oct. 31	4,386	— 4	31	73,050	+ 1,211	14 7	..
Wolverhampton	,, 30	1,634	— 13	30	26,657	+ 242	13·5	..
Yorks. W. Riding	Nov. 3	2 410	+ 600	44	51,409	..	..	..
Baker St.-Waterloo	,, 2	5 405	+1,700	18	42,705	+16,090	4·25	1
Cen. London Rly.	,, 2	11,286	—1,814	18	90,333	—14,275	6	..
Char. +, Eus. Hamp.	,, 2	5,475	+ 60	18	45,990	..	7·75	..
City & S. Lon. Rly.	,, 3	6 370	+ 620	18	55.000	+ 8,320	7·3	1·05
Dublin-Lucan Rly.	,, 1	227	+ 27	18	2,648	+ 231	7	..
G.N. and City Rly.	,, 2	3 522	— 181	18	29 306	— 691	3·5	..
G.N., P'dy. & Brmp.	,, 2	9,270	+ 40	18	73,150	..	9	..
L'pool Overh'd Rly.	,, 3	3,196	+ 341	18½	28,227	+ 1,728	6·8	4·3
Mersey Railway	,, 2	8 711	+ 222	18	32,987	+ 2,332	4 5	..
†Metropolitan Rly.	Oct. 27	15,374	+ 23	17	252,916	+ 5,742	24·5	..
Met. District Rly.	Nov.	16,329	— 76	18	134,807	— 611	24	..
Anglo-Argentine	Oct. 4	35,939	+2,747	44	732,700	+70,040	48	..
§Auckland	Sept. 18	2,905	+ 195	36	94,674	+ 3,608	19·2	·56
§Brisbane	Oct.	13,537	+1,816	..	..	..	..	..
§Brit. Columbia Rly.	Sept.	31,449	+7,897	13	91,083	+21,163	6·8	4·3
Calcutta	Nov. 2	5,498	— 750	..	..	..	..	..
§Cape Electric T. Ld.	August	9,240	..	..	..	..	..	..
§Geneva	,,	9 579	+ 627	..	..	..	..	..
§Kalgoorlie, W.A.	,,	4,549	..	35	31,955	..	20·5	..
Madras	Oct. 31	1,782	+ 184	43	32,986	+ 3,861	12·75	·5
§Lisbon	May	896	..	..	..	..	..	..
Perth (W.A.)	Nov. 1	2.877	+ 26	44	61,547	— 2,078	25·6	·4
†Buenos A. & Belgro.	,, 4	8,109	+ 295	44	169,123	+ 9,282	..	..

* Compared with the corresponding period of 1906. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Evening.

The times, in the Stock Exchange, are more out of joint than ever. For the Bank Rate to be advanced to 6 per cent. was bad enough; for it to be put up on a Monday, instead of the usual Thursday, made matters ten times worse. And it is quite possible that, before these melancholy notes see print, there may be a further advance in the Bank of England's minimum.

Wild speculation in the United States, which is responsible for all this monetary flurry, was largely in copper, the metal, and in copper companies' shares. The price of the metal having been forced up to an inflated price by manipulation based upon demand caused, to a great extent, by electrical industries, could not be maintained in the face of increasing supplies, and the crash in copper has much to do with the chaotic welter in American financial centres at the present moment.

At home, the railway crisis continues to be the subject of grave anxiety, which finds full reflection in the stock markets. The ballot of the A.S.R.S. rather cheered Home Rails, inasmuch as it showed that only some 12 per cent. of the total railwaymen in the kingdom were in favour of striking. All eyes, however, are fixed upon the Board of Trade, and Mr. Lloyd-George has the chance of his life for gathering laurels in exchange for olive branches. But the development of electric traction on the trunk lines must be sorely retarded by the shock administered to confidence in home railway securities by the labour agitation.

Central London Ordinary is 3½ points lower at 55½, and a threatened war between the Twopenny Tube and the omnibus proprietors is the latest unhappy move. The introduction of penny fares, as suggested, is a step over which there is much shaking of proprietors' heads, but the position, in view of the continual falling off in the traffics, would seem to call for drastic change somewhere.

City and South London declined a point. Great Northern and City Preferred shares changed hands at 30s. early in the week.

Cordial satisfaction may be expressed at the result of the new Canadian General Electric issue, particulars of which appeared in our last number. The subscription lists were closed two hours after opening. Results of this kind are all too uncommon nowadays, and the company deserves congratulation.

More cheeriness is apparent in the list of Telegraph stocks. Movements are patchy enough, but even this is an improvement, after the unanimous way in which prices have lately fallen, Marconi-driven. Eastern Ordinary recovered a point; rises of 5s. in Western Telegraphs and West India Second Preferences have occurred. The American group is naturally depressed; it is always swayed by the temper of Wall Street. Great Northerns and Indo-Europeans are both flat. The latter shares are just *ex* their 12s. 6d. dividend. Telegraph Constructions are two points lower.

Telephone issues are firm, with a slightly improving tendency. The two Debenture stocks of the National Telephone Company have advanced slightly. Deduction of the dividends upon Oriental Telephones and Monte Video Telephones resulted in little alteration being made in the prices.

Weakness is apparent in the Traction list. British Electric Preference fell 10s. to 5, half their normal par value. British Columbia stocks are lower, Calcuttas declined, Anglo-Argentine First and Second Preferences went the same way. There has been a general loosening of investment prices, consequent upon the dear money scare.

The Cape Electric Tramways report shows the company to be making some little headway, but, after transferring £4,000 to reserve, the directors have decided to carry forward the balance of £12,466, and not to pay any dividend. The shares are nominally about 6s. 3d.

Castner-Kellner Alkali shares are stronger in tone upon the declaration of a dividend at the rate of 16 per cent., making 12 per cent. for the year—an excellent performance.

Electricity supply issues are somewhat irregular. Brompton Ordinary, City Preference and London Electric Preference are easier, the falls amounting to very little. Charing Cross Ordinary picked up 2s. 6d., and South Londons, upon a sudden demand, are 7s. 6d. better. The buyer gave up to 2½ for shares, and when he was supplied, a fair number came into the market. Actually the present price is 25s. 6d. middle.

The Bank Rate.—Yesterday the Bank rate was raised to 7 per cent.

Rosario Electric Co., Ltd.—At the meeting of this company held last week, Mr. W. T. Western reported that there had been a substantial increase in business. Additional plant would have to be provided, and for that purpose, early in 1908 there would be offered to the shareholders £25,000 second preference shares.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations Oct. 29th.	Closing Quotations Nov. 5th.	Business done week ended Nov. 5th, 1907. Highest	Lowest.	Rise + or Fall −	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3 — 3½	3 — 8½	..	..	..	Nil
149,600	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	5 %	5 %	85 — 88	85 — 88	..	..	..	5 13 8
660,660	Anglo-American Telegraph	Stock	6ls.	2⅜%	3⅛%	3⅜%	51 — 54	51 — 54	53	51⅞	..	7 3 6
3,169,670	Do. do. do. 6 % Pref.	Stock	6 %	5⅛%	6 %	6 %	91 — 94	91 — 94	93½	91	..	6 7 8
3,169,670	Do. do. do. Deferred	Stock	2s.	Nil	⅛%	12⅝%	13⅛ — 13⅜	13⅛ — 13⅜	13¼	12⅞	..	12 14 0
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	..	5 %	5 %	99 —102	99 —102	..	..	..	4 18 0
44,000	Chili Telephone, Nos. 1 to 44,000	5	7 %	8 %	8 %	8 %	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	5 10 4
2,097,680	Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	8⅜ — 91	85 — 8⅛	88	..	−3	4 9 11
16,000	Cuba Telegraph	10	0 %	5 %	5 %	5 %	6 — 7	6 — 7	..	..	..	7 2 10
6,000	Do. 10 % Pref.	10	15 %	10 %	10 %	10 %	15⅝ — 16⅜	15⅝ — 16⅜	..	..	..	5 19 5
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3¼ — 3½	3¼ — 3½	..	..	..	5 14 3
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	9 — 9½	9 — 9½	..	..	..	5 5 3
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	8 18 2
60,710‡	Direct United States Cable	20	3 %	3½%	4½%	4⅝%	12½ — 13½	12¾ — 13½	13½	12½	..	6 19 1
57,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
4,000,000	Eastern Telegraph, Ord. Stock..	Stock	7 %	7 %	7 %	7 %	120 —125	121 —126	124	121	..	5 12 0
2,000,000	Do. 3½ % Pref. Stock..	100	3½%	3½%	3½%	3½%	80 — 83	80 — 83	82½	80	..	4 4 4
1,896,706	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	101 —104	99 —102 xd	101	99	−2	3 18 5
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	11 — 12	11 — 12	11⅝	11	..	5 16 8
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	99 —102	99 —102	99½	98½	..	3 18 5
295,400	East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1909	100	4 %	4 %	4 %	4 %	97½—100½	97½—100½	..	..	..	3 19 7
200,000‡	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100 —102	98 —100 xd	..	..	−2	4 0 0
181,127	Globe Telegraph and Trust	10	5⅛%	5⅜%	5⅛%	5⅛%	9 — 10	9 — 10	9½	9 3/32	..	5 10 0
181,127	Do. do. 6 % Pref..	10	6 %	6 %	6 %	6 %	12 — 13	12 — 13	12½	..	..	4 12 4
150,000	Great Northern Telegraph, of Copenhagen.. ..	10	15 %	24 %	24%	20 %	32 — 34	30 — 33	..	..	−1½	6 1 3
28,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
17,000	Indo-European Telegraph	25	10 %	13 %	13 %	13 %	54 — 56	52 — 55 xd	56	..	−1½	6 16 4
$41,380,400	Mackay Companies Common	$100	..	1 %	2 %	3⅛%	50 — 60	50 — 60	..	..	..	6 16 8
$50,000,000	Do. do. 4% Cum. Pref.	$100	..	4 %	4 %	4 %	£0 — 60	50 — 60	..	..	..	6 13 4
256,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	⅜ — 1	⅜ — 1	18/9	18/1½	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	4 %	5 %	6 %	1⅛ — 1 1/16	1⅛ — 1 1/16	..	..	..	4 14 1
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	⅞ — 1	⅞ — 1	..	..	..	5 0 0
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	106 —108	106 —108	107⅞	106¼	..	5 11 1
2,225,000	Do. do. Def. Stock	100	5 %	5 %	5 %	5 %	106 —108	106 —108	107⅞	106¼	..	4 12 7
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	10¾ — 12½	10¾ — 12½	12	11½	..	4 16 0
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	5 %	10 — 12	10 — 12	..	..	..	4 3 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5½ — 5¾	5¼ — 5½	5½	..	..	4 10 11
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	95½ — 97½	96 — 98	96	..	..	3 11 10
1,689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	98½—101¼	100 —102	100¾	..	+ ⅛	3 18 5
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	6⅛%	6½%	7 %	7 %	1⅝ — 1 11/16	1⅝ — 1⅞ xd	22/9	..	— 1/16	5 12 0
50,000	Do. do. 6 % Cum. Pref..	1	6 %	6 %	6 %	6 %	1⅝ — 1 11/16	1⅝ — 1⅞ xd	..	..	— 1/16	4 16 0
100,000	Do. do. do. 4 % Red. Deb. Stock ..	100	..	..	4 %	4 %	91 — 94	91 — 94	..	..	..	4 5 1
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
11,839‡	Reuter's	8	5 %	5 %	5 %	5 %	7 — 8	7 — 8	..	..	..	5 0 0
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	4½%	4½%	98 —101	98 —101	100	..	..	4 9 1
3,167	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	124 —127 xd	124 —127	..	..	..	4 14 6
80,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	5 10 4
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 10 11
15,600‡	West African Telegraph, Shares	10	4 %	4½%	4 %	4 %	10 — 10⅜	10 — 10⅜	..	..	..	3 16 2
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2	Nil	Nil	Nil	2½%	1 — 1⅛	1 — 1⅛	..	..	..	4 0 0
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930.. ..	10	7 %	7 %	7 %	7 %	12⅛ — 13⅛	12⅛ — 13⅛	13	12½	+ ⅛	5 3 8
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	99 —102	98⅜—101½	98½	..	— ½	3 18 10
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	1/16 — 1/8	1/16 — 1/8	8/4	..	..	Nil
34,569	Do. do. 6 % Cum. 1st Pref.	10	7 %	6 %	5 %	8 %	7 — 8	7 — 8	..	..	..	10 0 0
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	6¾ — 7⅛	6¾ — 7⅛	..	..	+ ⅛	Nil
80,000‡	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	99 —102	99 —102	..	..	..	4 18 0

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, 10 % Nom. Cum. 2nd Pref., 260,008 to 580,097	5	..	8 %	8 %	8 %	7⅛— 7⅞	7⅜— 7⅝	7⅝	7 7/16	— ⅛	5 3 3
260,007	Do. 6 % Cum. Prefs., 1 to 260,007 ..	5	5⅛%	5⅛%	5⅛%	5⅛%	5⅛— 6 1/16	5⅞— 6⅛	6 1/16	5⅛⅛	— 1/16	4 9 10
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	131 —134	131 —134	..	..	..	4 9 7
285,100	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	102 —105	102 —105	..	..	..	4 15 8
880,000	Babcock & Wilcox, 1 to 580,000..	1	17 %	20 %	20 %	20 %	3⅛— 3⅜	3⅛— 3⅜	75/6	73/1½	+ ⅛	5 3 11
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1 1/16— 1 1/8	1 1/16— 1 1/8	..	..	..	3 16 10
88,000	British Aluminium, Ord., 2,001 to 40,000	5	..	7 %	7 %	7 %	4 — 5	4 — 5 xd	87/6	..	..	7 0 0
40,000	Do. do. 7 % Cum. Pref.	5	Nil	7 %	7 %	7 %	4⅞— 5⅛	4⅞— 5⅛ xd	..	..	..	6 10 8
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	6 %	6 %	6 %	4⅛— 5	4⅛— 5	..	..	..	6 0 0
20,000	Do. do. 4 % Funding Certs.	5	..	4 %	4 %	4 %	3⅞— 4⅛	3⅞— 4⅛ xd	..	..	..	4 14 1
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	100 —103	100 —103	..	..	..	4 17 1
300,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	5½%	96 — 99	96 — 99	96½	..	..	5 11 1
400,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	6 %	6 %	6 %	130 —135	128 —133	..	..	−2	4 10 3
300,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	5 %	112 —116	112 —116	..	..	..	4 6 2
300,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	104 —107	101 —105	..	..	−3	4 15 8
238,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	98 —101 xd	98 —101	..	..	..	4 7 5
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	102 —104	102 —104	..	..	..	4 6 7
133,301	British Electric Traction	10	6 %	6 %	3 %	Nil	1⅞— 2⅛	1⅞— 2⅛	..	..	..	Nil
161,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %	5½ — 5⅝	4⅞— 5⅛	5⅛	99/9	— ⅛	11 8 6
1,448,853	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	95 — 98	94 — 97	..	..	−1	5 3 1
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	4½%	4½%	4½%	76 — 80	74 — 78 xd	..	..	−2	5 15 5
100,000	British Insulated and Helsby Cables	5	8 %	8 %	8 %	10 %	6⅛— 7	6⅛— 7	..	..	..	7 2 10
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅝— 6⅛	5⅝— 6⅛	..	..	..	4 18 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red. ..	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	85 — 89	85 — 89	..	..	..	4 18 11
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	6 %	Nil	Nil	Nil	⅞— 1⅛	⅞— 1⅛	21/10½	..	..	Nil
1,016,853	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	55 — 65	55 — 65	..	..	..	6 3 1
50,000	†Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	⅞— 1⅛	⅞— 1⅛	..	..	..	Nil
50,000	† Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	2½%	Nil	½— ¾	½— ¾	..	..	..	Nil
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	Nil	¾— 1⅛	¾— 1⅛	15/-	..	..	Nil
125,000‡	Do. do. 4½ % Perp. Deb. Stock	Stock	4½%	4½%	4½%	4½%	83 — 86	83 — 86	..	..	..	5 4 8
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	67 — 70	67 — 70	..	..	..	6 8 7
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	3 %	4 %	3 %	3 %	4⅞— 4⅞	4⅞— 4⅞	90/6	88/9	..	8 4 0
40,000	Do. do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	6 %	4½— 5⅛	4½— 5⅛	..	..	..	5 14 3
27,500	Do. do. "B" do., 1 to 27,500	5	6 %	6 %	6 %	6 %	4½— 5⅛	4½— 5⅛	..	..	..	5 14 3
13,200	Do. do. 5 % Deb. Stock	100	5 %	5 %	5 %	5 %	105 —115	105 —115	..	..	..	4 6 11
190,000	Do. do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	5 %	102 —105	102 —105	..	..	..	4 15 3
187,610	Calcutta Trams, 1 to 187,610	5	6 %	8 %	8 %	8 %	6⅞— 7⅛	6⅞— 7⅛	7⅛	6 1/16	— ⅛	5 12 3
30,000	Do. 5 % Cum. Pref., Nos. 1 to 29,330..	5	..	..	5 %	5 %	5 — 5⅛	5 — 5⅛	5 1/8	..	..	4 10 11
350,000	Do. 4½ % 1st Deb. Stock..	100	4½%	4½%	4½%	4½%	100 —104	100 —104	..	..	..	4 6 7
35,000	Callender's Cable Construction shares ..	5	12½%	12½%	15 %	15 %	9⅜— 10⅜	9⅛ — 10⅛ xd	..	..	..	7 6 4
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	5⅜	..	..	4 6 11
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	102½—107½	105¼—107½	105½	..	..	4 3 4
491,222	Cape E Trams., 1 to 491,222	1	10 %	5 %	Nil	Nil	⅜— ½	⅜— ½	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	4 %	6 %	8 %	1 1/16— 1 1/8	1 1/16— 1 1/16	27/6	26/3	+ ⅛	5 11 4
224,988	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	4½%	98 —102	98 —102	..	..	..	4 8 3
911,568	Central London Railway, Ord. Stock..	Stock	4 %	4 %	4 %	4 %	58 — 60	54 — 57	56	55	−3½	7 0 4
544,216	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	85 — 87	85 — 87	..	..	..	4 12 0
544,216	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	40 — 43	40 — 43	42	40⅜	..	9 6 0
1,480,000	City and South London Railway	Stock	2⅜%	2⅜%	1¼%	2½%	44 — 46	43 — 45	44⅞	43⅜	−1	4 14 5

* Unless otherwise stated, all shares are fully paid. † A period of nine months. ‡ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Oct. 29th.	Closing Quotations Nov. 5th.	Business done week ended Nov. 5th, 1907.		Rise + or Fall —	Present Yield per cent.
		*	1903.	1904.	1905.	1906.			Highest	Lowest.		£ s. d.
85,000	Crompton & Co., Nos. 1 to 85,000	8	2½%	2½%	2½%	5 %	1⅝ — 2	1 11/16 — 1 13/16	..	..	— ⅛	8 6 8
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	96 — 99	96 — 99	..	..	..	5 1 0
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	10 %	10 %	10 %	1¾ — 1⅞	1¾ — 1⅞	27/3	..	..	6 13 4
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	6 %	1 — 1⅛	1 — 1⅛	..	..	..	4 16 0
294,150	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
60,000	Dublin United Trams. (1896), 1 to 60,000	10	5⅝%	6 %	6%	6 %	13 — 14	13 — 14	..	..	..	4 5 9
59,987	Do. 6 % Pref. between 1 and 60,000	10	6 %	6 %	6 %	6 %	12⅞ — 13⅛	12⅞ — 13⅛	..	..	..	4 7 3
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	Nil	2½%	4½%	4½%	1 — 1⅛ xd	1 — 1⅛ xd	..	..	..	9 11 1
17,139	Do. "A" shares, 61—017,139	5	Nil	2½%	4½%	4½%	2⅛ — 2⅜	2 — 2⅛ xd	..	..	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	83 — 85	83 — 86	..	..	..	4 14 2
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	87 — 90	87 — 90	..	..	..	5 11 1
112,100	Electric Contruction, 1 to 112,100	2	4 %	Nil	Nil	Nil	1/16 — 3/16	1/16 — 3/16	..	..	..	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	Nil	1/2 — 1	1/2 — 1	..	..	..	Nil
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	4 %	5 %	5 %	5 %	8 — 8¼	8 — 8¼	..	..	..	5 17 8
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	89 — 92	89 — 92	..	..	—1	4 19 11
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	3 %	4 %	4 %	4 %	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..	20 0 0
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10½ — 10⅞	10½ — 10⅞	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103	102 —103	..	..	..	4 17 1
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15 %	15%	15 %	10⅜ — 11⅛	10⅜ — 11⅛	..	..	..	6 10 0
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5 — 5⅛	5 — 5⅛	..	..	..	3 17 3
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	105½—107⅛	105½—107⅛	..	..	..	4 3 9
50,000	India-Rubber, Gutta-percha & Telegraph Works.	10	10%	5 %	10%	10 %	14⅜ — 15⅛	14⅜ — 15⅛	..	..	..	6 13 4
37,500	†Liverpool Overhead Railway, Ord.	10	1⅜%	1⅜%	Nil	Nil	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..	Nil
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	7⅞ — 8	7⅞ — 8	..	..	..	5 14 11
600,070	London United Trams. (1901), 1 to 50,007	10	8 %	6 %	8 %	8 %	6¾ — 7⅛	6⅝ — 7⅛	..	..	..	4 0 0
399,980	Do. do. 60,008 to 100,000	10	8 %	6 %	8 %	8 %	6¾ — 7⅛	6¾ — 7⅛	..	..	..	4 0 0
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	5 %	7⅞ — 8⅛	7⅞ — 8⅛	..	..	..	5 14 8
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	82 — 86	82 — 86	..	..	..	4 13 0
314,016	Metropolitan Electric Trams., Defd.	1	Nil	Nil	Nil	Nil	1/16 — 3/16	1/16 — 3/16	..	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	31/32 — 1 1/32	31/32 — 1 1/32	..	..	..	5 2 7
350,000	Do. do. 4½ % Deb. Stock Red.	100	..	4½%	4½%	4½%	94 — 97	93 — 96	..	..	—1	4 13 9
245,500	Potteries E. Trc.	1	5 %	5 %	4 %	4 %	1/16 — 3/16	1/16 — 3/16	..	..	..	7 2 3
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/32 — 3/32	1/32 — 3/32	..	..	..	6 13 4
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
37,350	Telegraph Construction and Maintenance	12	20 %	15 %	15 %	15 %	30 — 32	27 — 30	30½	28	— 2½	6 0 0
150,000£	Do. 4 % Ded. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	99½—102½	99½—102½	..	..	..	3 18 1
599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	5 %	5 %	5 %	44 — 49	44 — 49	44½	..	..	10 4 0
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	3 %	Nil	Nil	..	1¾ — 1⅞	1 — 1½	..	..	— ¼	Nil
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	Nil	Nil	..	3½ — 4¼	3½ — 4	76/3	..	— ¼	Nil
246,574	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	75 — 80	75 — 80	..	..	..	5 0 0

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P,. 1 to 14,000	5	5 %	5⅛%	5⅛%	5⅛%	4⅝— 5⅛	4⅝— 5⅛	..	..	..	5 7 4
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	98 —100	95 — 98 xd	..	..	..	4 11 10
29,798	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10 %	10%	7⅝ — 8	7 — 8	..	..	— ½	6 5 0
10,202	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7¼ — 8¼	7¼ — 8½	..	..	..	4 4 10
836,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..	8 19 3
80,000	Charing Cross and Strand Electricity Supply	5	8 %	8 %	5 %	5 %	3⅝— 4⅛	3⅝— 4⅛	..	..	+ ⅛	5 17 8
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	3⅝— 3⅞	3⅝— 3⅞	72/6	..	..	5 0 0
80,000	Do. "City Undertaking" 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	3⅝— 3¾	3⅝— 3¾	72/6	..	..	5 16 2
427,400	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	96 — 99	97 —100	97½	..	+ 1	4 0 0
49,496	Chelsea Electricity Supply, Ord.	5	5⅛%	6 %	6 %	4½%	3¾ — 4¼	3¾ — 4¼	..	..	..	5 5 11
175,000£	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
70,595	City of Londo Elec. Lighting, Ord. 40,001—110,595	10	5 %	6 %	6 %	6 %	8⅝ — 9⅛	8⅝ — 9⅛	9⅛	9¼	..	6 3 1
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	10¾ — 11⅛	10¼ — 11¼	11¼	10⅝	— ⅛	5 11 8
400,000£	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	122 —125	122 —125	..	..	..	4 1 4
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	97 —100	97 —100	..	..	..	4 10 0
40,000	County of Durham Electrical Power, Ord.	5	4 %	£3 7 0	4 %	4 %	3½ — 4¼	3½ — 4¼	..	..	..	4 14 1
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	4⅜ — 4⅝	4⅜ — 4⅝	..	..	..	5 2 7
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4½%	5 %	5 %	6¼ — 7⅛	6⅛ — 7	6 13/32	..	— 5/32	7 2 10
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10¾ — 11⅛	10 — 10⅝	10 13/32	10 5/8	— 5/32	5 11 8
400,000£	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	107 —110	107 —110	..	..	..	4 1 10
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	4 %	Nil	⅛ — 1	⅛ — 1	..	..	..	11 0 0
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	3 %	1 — 1⅜	1 — 1⅜	..	..	..	8 11 5
350,000	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	76 — 81	76 — 81	..	..	..	5 11 1
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	5 4 9
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	5 %	5 %	4⅛ — 5⅛	4⅞ — 5⅛	..	..	..	4 18 0
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
13,000	Hove, 1 to 13,000	5	8½%	8½%	9 %	9 %	6¼ — 7 xd	6¼ — 7	..	..	..	6 8 7
21,000	Kensington and Knightsbridge Electric Ord.	5	12½	12 %	10 %	10 %	8½ — 9¼	8½ — 9¼	..	..	..	5 8 1
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	95 — 98	95 — 98	..	..	..	4 1 8
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	3 %	4 %	4 %	1½ — 1⅝	1½ — 1⅝	..	..	..	6 16 2
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4⅛ — 4⅜	4 — 4½	..	..	— ⅛	6 13 4
374,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4½%	89 — 93	89 — 93	..	..	..	4 16 9
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8½%	10 %	10 %	8 %	5⅛ — 5⅝	5⅛ — 5⅝	5⅝	5½	..	6 19 2
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅝ — 5⅛	4⅝ — 5⅛	..	..	..	4 7 10
220,000£	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	100 —107	103 —107	..	..	..	4 10 0
250,000£	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	87 — 92	87 — 92	..	..	..	3 16 1
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	96 — 98	95 — 98	..	..	..	4 11 10
87,500	Newcastle-on-Tyne, 1 to 87,500	5	8 %	8 %	8 %	8 %	6½ — 6⅝	6½ — 6⅝	..	..	..	5 18 6
87,500	Do. 5 % Pref., 1 to 87,500	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 10 11
10,852	Notting Hill Electric Lighting	10	6 %	7 %	7½%	7½%	11 — 12	11 — 12	..	..	..	6 5 0
20,000	Oxford, 1 to 96 and 407 to 20,310	5	6½%	7 %	7 %	7 %	5⅛ — 6	5⅛ — 6	..	..	..	5 16 8
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	95 — 97	95 — 97	..	..	..	4 2 6
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	12½%	10 %	7½ — 8⅛	7½ — 8⅛	..	..	..	6 1 8
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6 — 7	6 — 7	..	..	..	5 0 0
150,000£	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3 %	3½%	86 — 91	86 — 91	..	..	..	3 16 11
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	4 %	Nil	⅛ — 1⅛	⅛ — 1⅛	..	..	..	Nil
50,000	Do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	71 — 75	71 — 75	..	..	..	6 0 0
65,000	South London Electricity Supply, Ord.	5	3 %	4 %	4 %	3 %	1⅞ — 2⅛	2¼ — 2⅜	42/6	40/7½	+ ⅜	5 9 1
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	Nil	2½%	2½%	⅜ — ½	⅜ — ½	..	..	..	3 6 8
117,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1 1/16 — 1⅛	1 1/16 — 1⅛	..	..	..	6 17 11
200,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..	11 10 6
65,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	1⅛ — 2	1⅛ — 2	..	..	..	8 13 11
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	..	4½%	4½%	4½%	92 — 95	92 — 95	..	..	..	4 14 9
110,000	Westminster Electric Supply, Ord.	5	15⅝%	14 %	13 %	12 %	8¼ — 9¼	8½ — 9½	8½	..	..	6 9 9
61,279	Do. do. 4½ % Cum. Pref. (Original 5 %—Red. to 4½ % from 31st Dec., 1905)	5	5 %	5 %	5 %	4½%	4½ — 5⅛	4½ — 5⅛	..	..	..	4 5 9

* Unless otherwise stated, all shares are fully paid.

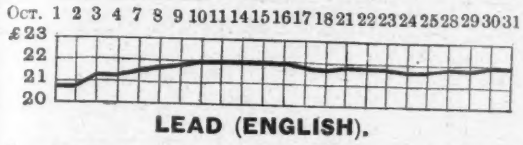
† Quotations on Liverpool Stock Exchange.

Bank rate of Discount 6 per cent., November 4th, 1907.

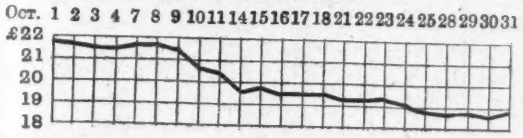
METAL MARKET.

Fluctuations in October.

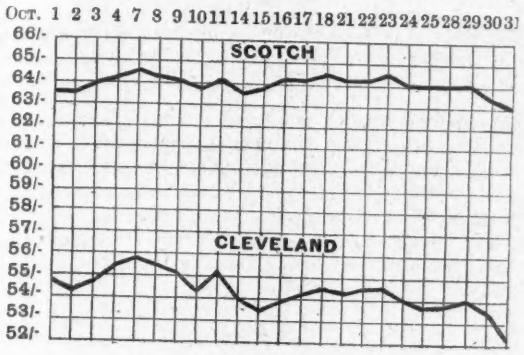
SPELTER (G.O.B's.).



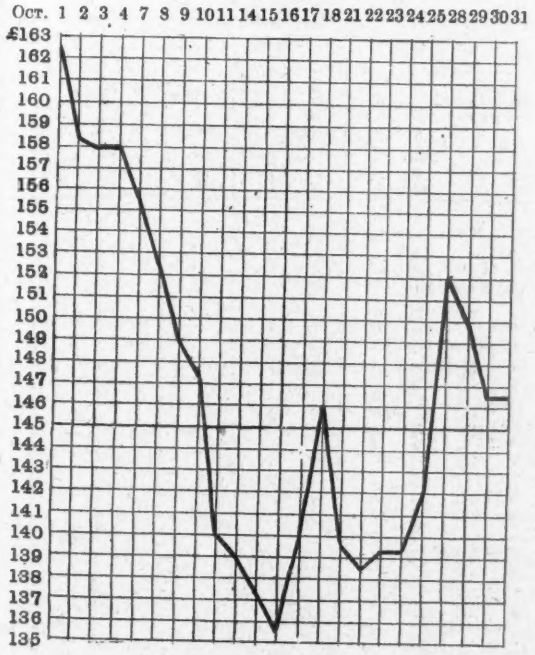
LEAD (ENGLISH).



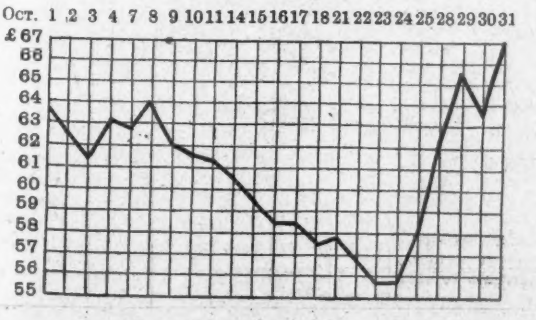
IRON.



TIN.



COPPER (G.M.B's.).



ELECTRIC TRAMWAY ACCOUNTING AND FINANCE.

By ELECTRIC.

(*Continued from page* 720.)

Weekly Engineering Wages.—Both the traffic and the engineering wages may be included, of course, in one wages book, with an increase in the number of columns for the allocations; but where the engineering wages are kept separately, the ruling of the book will be somewhat as follows:—

Name.	Description.	Time.							Total.	Rate.	Amount.	Deductions.	Amount payable.	Allocations.							
														R. & M. p. way.	R. & M. E. equipment.	R. & M. rolling stock.	R. & M. tools.	Cap. E. equipment.	Cap. p. way.	Cap. tools.	&c., &c.

The above analysis indicates a few of the titles to which the expenditure is allocated in the ordinary course.

The engineering salaries are usually paid by cheque, the form of the pay-sheet being similar to the above, with proper titles for the allocations.

When the analysis of the traffic and engineering wages and salaries is indicated on sheets, these should be separately bound at the end of each year, a yearly summary prepared, and the postings made directly therefrom to the accounts concerned, the summary forming part of the bound book.

Ordering of Stores.—It is the invariable practice for all stores and materials to be ordered from the head office upon proper requisitions furnished by the Traffic and Engineering Departments, all advice notes being sent to the manager or engineer, as well as the invoices which are checked as for condition of goods, quantity, price additions, extensions, and so on, allocated, certified and sent to the head office for payment.

Invoices and Stores.—There are various methods of dealing with invoices and stores, one of them being for the invoices to be handed to the storekeeper (such as relate to him), and after being found to be in order, or after correction, they are checked with the entries which he has made in his stores ledger from the advices and receipt of goods taken into stock, the stores being arranged and indexed according to description. The issues of stores are made upon the production of authenticated and allocated requisitions, which are carefully kept, the issues being posted directly therefrom to the credit of the stores accounts to which they refer. Posted to date, the difference between the debit and credit of each description shows the quantity and value of stores on hand. The stores received and taken into stock, as well as the issues therefrom are entered, of course, at cost. At the end of each month a statement is prepared from the Stores Ledger, showing what stores have been taken into stock, and the allocated issues therefrom. The form may be as below. (See Table A, page 786.) It may be added that it is desirable to bind these forms at the conclusion of each year, prepare a summary of the monthly totals and post directly from the summary to the accounts to which the vertical totals relate, the summary forming part of the bound book.

Ticket Stock Returns.—The tickets delivered to, and accepted by, the local office are recorded in the Ticket Stock Book, which may be ruled as below:—

Route.							1d. tickets.										
Date.	By whom supplied	No. supplied.	Nos.		Price.	Amount.	Issues.										&c.
			From	To.			Date.	No.	Nos.		Amount.	No.	Nos.		Amount.		
									From	To			From	To			

TABLE A.

THE A.B. ELECTRIC TRAMWAY CO., LTD.

Receipts, Issues, and Analysis of Stores for Month of 19 .

Receipts.				Issues.			Allocation.													
									Repairs and maintenance.						Capital.					
Date.	Name.	Particulars.	Amount.	Date.	Registration.	Amount.	Clothing.	Tickets.	Buildings.	Permanent way.	Electrical equipment.	Cars.	Tools.	&c., &c.	Buildings.	Permanent way.	Electrical equipment.	Cars.	Tools.	&c., &c.
		Stock at beginning of period																		
		Stores and materials taken into stock as per summary of invoices attached during the period																		
		Deduct total issues as per "Issues" Column ..																		
		Stock at end of period ..																		

Periodical returns are made to the head office in some undertakings of the tickets received and issued, as follows :—

A.B. ELECTRIC TRAMWAY CO., LTD.

Ticket Return for the Month of , 19 .

Particulars.	1d.	2d.	3d.	4d.		Total.
Stock of tickets at beginning of period						
Tickets received during the period						
Total						
Tickets issued during the period...						
Tickets in stock 19						

At the close of business on the last day of the financial year, the practice obtains in some concerns for the company's auditor or one of its officials to take the stock, which should agree, of course, with the ticket stock return subsequently sent to the head office by the local office.

Advertising.—Sometimes a substantial revenue is derived from ticket and car advertisements. The arrangements in connection therewith, however, assume various forms. In some cases the revenue from the ticket advertisements is retained by the contractor who supplies the tickets, he in exchange making a concession in the price of the tickets supplied. In others the advertising is carried out by the contractor for a specified commission upon the nominal amount of each advertisement or upon the actual amount of collection. Similarly in regard to the car advertisements.

Control of Expenditure.—It is a good practice to require the different departments to submit monthly statements of the expenditure that they are likely to incur, thus affording a control and check and enabling the management to make any necessary arrangements in regard to finance.

Where an electric tramway company generates its own current for the purpose of the tramway, the stores, materials, salaries, wages and expenses in connection therewith constituting "power expenses" take the place of energy purchased, and where a tramway company, in addition to providing its own current, also supplies electrical energy under an order for public and private lighting and for power purposes, it is necessary to keep the tramway and lighting sections distinct, the usual course being for the tramway section to charge the lighting section on the basis of agreed rates or tariff for the energy supplied, the result in any case being unchanged so far as the company in its entirety is concerned. In cases where a lighting company has obtained an order, and subsequently a tramway order, the order of things is reversed : but the principle is undisturbed. To secure the distinctiveness of account keeping between the tramway and lighting sections of a company does not call for the exercise of any ingenuity.

The object to bear in mind is that the accounts must be kept so that at the end of the financial year the following data may be prepared readily therefrom, viz. :—

(*a*) Capital account.
(*b*) Capital expenditure. Lighting.
" " Tramway.
(*c*) Revenue account. Lighting.
" " Tramway.
(*d*) General revenue account, embodying the result of (*c*).
(*e*) General balance-sheet, showing the lighting and traction items separately.

In some cases what are called "working accounts" are framed for the lighting and traction sections, with a general revenue account to which the results are transferred from these working accounts, such items as administration and general expenses, debenture interest, and so on, being indicated in the general revenue account only. At a more convenient stage we shall have a few observations to make upon these accounts.

TABLE B.

THE A.B. TRAMWAY CO., LTD.

Cost return for period of ——— *ending* ———, 190 .

Description of expense.	Detail.	Amount.	Total.	Per car-mile. This year.	Per car-mile. Corresponding period of previous year.	Remarks.
Traffic.						
Salaries						
Wages of motormen and conductors						
Inspection ...						
Clerical and storekeepers' wages ...						
Track and car cleaning... ...						
Tickets						
Clothing						
Water						
Light						
Punch hire ...						
Energy						
Distribution.						
Salaries						
Wages						
Stores						
*Repairs: Wages						* This will include overhead equipment, cables, section-boxes and sundries.
Stores						
Permanent way.						
Repairs: Wages						
Stores						
Renewals: Wages						
Stores						
Buildings.						
Repairs: Wages						
Stores						
†*Rolling Stock.*						† This will embrace car bodies and electrical and mechanical equipment of cars.
Repairs: Wages						
Stores						
Administration.						
Total for period...						
Aggregate to date						

The subject of costing is of the first importance, the technical phrase in relation to its application to tramways being "terminal costs." In electric tramway undertakings the preparation of the cost return is frequently elaborated to an extent so voluminous as to be approximate, and theoretical in many composite details, and consequently often misleading, whilst such returns are, no doubt, more criticised by those who least understand their compilation and object. They are, as a general rule, drawn on the lines of Table B, page 786.

Where "generation" takes the place of "purchase of energy," it is desirable to allocate a separate space for the items usually comprised under that heading, and we cannot do better than follow largely the arrangement in the Board of Trade form of Revenue Account, viz. :—

1. Coal or other fuel.
2. Oil, waste, water and engine-room stores.
3. Salaries.
4. Wages.
5. Repairs and maintenance :—(*a*) Buildings ; (*b*) Engines and boilers ; (*c*) Dynamos, exciters, &c. ; (*d*) Other machinery ; (*e*) Accumulators ; (*f*) Sundries.

Wages and Stores are indicated separately for each of the items (*a*) to (*f*) where this may be of practical importance.

Concurrently with the Cost Return, and for the same period, it is usual to prepare abstracts of the Receipts and Expenditure, which may take the following forms :—

Abstract of Expenses for the Period of *Ending*

Description.	Amount.	Per car-mile.	Corresponding period of previous year.	
			Amount.	Per car-mile.
Traffic				
Distribution ...				
Permanent way ...				
Buildings				
Rolling stock ...				
Administration ...				
Total for period ...				
Total to date ...				
Increase / Decrease for period				
Increase / Decrease to date ...				

It is a common practice to compile from the manager's records statistics, such as dead mileage, lost mileage, units per car-mile and others, some of which are of undoubted value, whilst others are merely for the delectation of the small pedantic theoretical mind. Where the company generates its energy, it is necessary to compile statistics showing, *inter alia*, the plant installed in KW., units generated, units used in the power station, units sent out, station load factor, running plant load factor, quantity of fuel used for every unit generated, and so on.

For each board meeting, it is customary to prepare a statement of the current financial position of the company. There are various forms in use ; but the following may serve as an example :—

THE X.Y.Z. ELECTRIC TRAMWAY CO., LTD.

Authorised share capital.. £

Issued share capital. £

Debenture capital.

Authorised ... ... £
Issued ... ... £

Balance at Bank as per last account ... ... £

Receipts since banked—

£
£
£

Receipts not credited—

£
£

Bank Payments.

Cheques not presented, as per last account ... ... £
Cheques signed at last financial meeting ... ... £
Cheques signed since last financial meeting ... ... £
Bank charges ... ... £
Transfers to deposit or other accounts ... ... £
Bills payable ... ... £

Deduct cheques not presented £

Balance as per bank pass book ... ... £

(*Continued on next page.*)

Abstract of traffic and other receipts for the period of *ending*

Route.	No. of cars.	This year.		To date.		Corresponding period of previous year.			To date of previous year.		Increase.				Decrease.			
											This year.		To date.		This year.		To date.	
		Amount.	Per car-mile.	Amount.	Per car-mile.	No. of cars.	Amount.	Per car-mile.	Amount.	Per car-mile.	Amount.	Per car-mile.	Amount.	Per car-mile.	Amount.	Per car-mile.	Amount.	Per car-mile.
Traffic receipts—																		
(Routes)																		
Total																		
Other receipts—																		
Total																		
Aggregate																		

SUMMARY OF ABSTRACTS.

—	This year.		To date.		Corresponding period of previous year.		To date of previous year.		Increase.				Decrease.			
									This year.		To date.		This year.		To date.	
	Amount.	Per car-mile.	Amount.	Per car-mile.	Amount.	Per car-mile.	Amount.	Per car-mile.	Amount.	Per car-mile.	Amount.	Per car-mile.	Amount.	Per car-mile.	Amount.	Per car-mile.
Abstract of traffic and other receipts... ...																
Abstract of expenses ...																
Balance Dr. Cr.																

Balance as per Bank Pass-Book or above ... ... £
Receipts paid to Bank as per cash book, but not credited by Bank at date of report ... ... £
Deduct cheques not presented ... £

Balance as per cash book ... ... £

Balance as per cash book as above ... ... £
Deduct cheques for accounts submitted to-day for payment ... ... £

Add amount on deposit or other accounts ... ... £

£

Particulars.	Total amount authorised to date.	Discharged.	Balance undischarged.
Estimated requirements, viz.:	£		
	£		

Estimated amount required during the ensuing period, £ .
Bills payable _____

(Date) _____ .

(*To be continued.*)

DEFECTIVE LIGHTNING CONDUCTORS.

By J. H. R.

Ninety-five per cent. of the cases of faulty lightning conductors that have come under our observation have been due to bad earth connections. The remaining 5 per cent. were traceable to (*a*) loose rag bolts near the apex of the conductor, causing the collapse of the latter, to (*b*) imperfect metallic joints about the finial rod, and to (*c*) oxidation. Not infrequently a large building is fitted with a solitary conductor, whilst vulnerable parts are left unprotected. Whether the number of conductors should be directly proportional to the magnitude of an edifice and what actually constitutes the danger zone of a lightning flash are questions that cannot be adequately treated under the heading of "*defective* lightning conductors" without unwarrantable digression—a mistake that will not be made. Exceptional combinations of circumstances call for special consideration, and hence it is desirable to have the opinion of someone whose theoretical knowledge has been supplemented by a wide experience. Within certain limits a defective conductor becomes dangerous, as discharges of atmospheric electricity can find a path to earth through some part of the building offering less electrical resistance.

Most of your readers would have supposed that all the difficulties before mentioned and hereafter considered must have been surmounted long ago, and that in regard to them nothing remains to be said. Seeing that standard works on the subject are obtainable, that lectures have been given and valuable papers read before various public and scientific institutes showing how to differentiate between good and bad conductors, it is certainly surprising that so many *preventable* faults continue to occur. Either the jerry contractor secures most of these jobs, or else the average client is reluctant at incurring the slight expense consequent upon a periodical test; possibly a combination of both misfortunes is the correct explanation. It would appear that the public are supremely indifferent concerning the efficiency of their conductors so long as the finials point vertically towards heaven. Instances could be recorded where lightning conductors have been neglected throughout a period of 15 years. Nowadays it is considered good practice to make an inspection and test at least once per year. The company with which the writer is identified makes it a rule that all conductors shall be tested every six months. A report is afterwards submitted detailing the resistance in ohms and the state of the weather during testing operations. A comparison can then be made with the previous record, an increase in the electrical resistance noted, and the probable development of a fault ascertained.

As a rule, the technical Press gives encouragement to any writer having a story to tell, providing it is well told, is not too long, and is worth telling. Some time ago one of your contemporaries published an article upon a subject that need not be specified. The sentences were well balanced, and the composition all that could be desired. When, however, the author attempted to define a "good earth," he stated that the copper plate should be buried in *cinders!* Suspicion was at once aroused as to whether that author had ever been responsible for the maintenance of an installation of lightning conductors, or of telegraphs, or indeed of any electrical system where a low resistance to earth was a desideratum. If coke had been named in preference to cinders, comment would have been superfluous; if the unconsumed pieces of arc lamp carbons had been recommended as being vastly superior to either, the advice would have been excellent, and no complaint could have then been urged against the article, which in other respects was commendable.

Reference has been made to jerry contractors. A gentleman of this class secured the contract for the protection of a large warehouse on the recommendation of his being a local man. Four main conductors of copper tape were specified, and the work was commenced in due course. His method of procedure was more interesting than convincing. Instead of completing one conductor at a time, all four were left in a partly finished state. Within 6 ft. of the ground the free end of each conductor was coiled up and wedged into a chase of the warehouse wall or other suitable aperture—there to remain pending the arrival of the copper plates and until a suitable subsoil had been decided upon. As this occurred in midsummer when thunderstorms were prevalent, the contractor received peremptory orders to complete the underground portion forthwith, or temporarily remove the aigrette rods. In adopting the course last named, he did so with no good grace, being annoyed that anyone should presume to suggest something relative to his business with which he was not already acquainted. "Why!" he expostulated, "I once fitted a conductor to a town hall, and bored holes all over the earth plate—a contract that gave every satisfaction." "What was the object of the perforations?" inquired a bystander, "Was it to allow the lightning a means of escape?" "Certainly!" he replied, with condescending frankness.

The number of faults caused through copper earth plates being laid in dry shallow ground is far in excess of what might reasonably be expected; whilst the quantity of oxidised conductors—terminating in putrid earthen-ware drains—is by no means small. Bad workmanship can never be condoned. Granted that it is not always an easy matter to find a "wet" earth, unless excavations are continued to an abnormal depth, the fact should not be lost sight of that difficulties are things to be overcome. More than one solution is, of course, possible, but on several occasions an attachment of the copper tape has been made with an adjacent water pipe, thereby dispensing with the customary ground plate. Under these conditions the resistance to earth will rarely exceed 0·25 ohm, and our experience justifies the opinion that electrolytic action need not be feared. Nevertheless, in certain quarters there is still an objection to water-pipe attachments, and in others the reliability of such connections is thought doubtful. Was it not Descartes who wrote "a man can more easily burn down his own house than get rid of his prejudices?" Any apprehension ought surely to have been dispelled after the pronouncement of Lord Kelvin on the subject. In the discussion following Sir Oliver Lodge's paper before the Institution of Electrical Engineers, his Lordship stated that "*an ordinary house can be made exceedingly safe by connection with the water pipes.*" "I would connect all pieces of metal to each other and to the earth if you can; but if you cannot (in the absence of water mains) connect each of them to an earth, then connect them to the lightning conductor, and give *it* a good earth." Inattention to an important detail may render even this excellent arrangement unsatisfactory. An

electrical engineer who claims to have applied his system of protectors in all parts of the United Kingdom, once explained that he never made a practice of sweating the conductor to the underground pipe. All that he believed necessary was to wrap the metal tape two or three times round the water main, then bolt the loose end back to the conductor proper, finally smearing the whole with a coat of black varnish. Whether it is not the better plan to metallically unite the conductor and pipe by means of a lead pot or blow lamp may be left to the judgment of those of our readers sufficiently interested to consider the point raised. A standard specification for lightning conductors throughout the United States Navy has lately been issued, and one clause prescribes that every joint shall be "sweated with solder."

A ridiculous method of completing a conductor was discovered a few years ago whilst staying at the residence of a friend. The finial soared proudly above the chimney pots in orthodox fashion. The copper rope was carefully separated from the wall side by means of glass insulators resembling the ink wells of boyhood memory. An old cottage oven situate at pavement level served as a receptacle for the end of the conductor, and the oven door as a lid for inspectional purposes. As might be surmised, the oven was found dry and rusty, whilst the copper rope, coiled therein, was covered with verdigris. Inquiry elicited the news that the coachman was expected to fill the oven with water as, and when, required, but that pressure of business had led to the duty being overlooked. This antiquated oven was eventually "scrapped" and a copper plate, buried deep in damp soil, was substituted; a plentiful supply of coke improved matters so far as conductivity was concerned. The glass insulators referred to were replaced by suitably shaped hold-fasts and a first-class repair effected. This latter tribute to good workmanship is all the more willingly paid since the writer had no pecuniary interest in the affair whatever.

Thefts of copper plates on completion of a contract are happily rare though not imaginary occurrences. Should the offender escape immediate detection, a periodical "bridge" test will reveal unworthy tactics of this sort whether practiced by an unscrupulous employé or equally discreditable employer.

It will be generally conceded that in the class of faults to which attention has been directed there must have been a flagrant neglect of the principles governing the erection of lightning conductors; yet *on no occasion was the building damaged by lightning*. To infer from this admission that a building is as safe without a conductor as if one were provided would be distinctly wrong; and such a deduction could not be maintained without disregarding all that modern science has established on the subject.

Rather do the foregoing incidents tend to demonstrate the value of conductors, notwithstanding that forgetfulness and other causes had led to the development of certain objectionable features.

Lightning is an electric discharge, and as such it should act in accordance with known law. Thus, if a conductor fastened to a chimney stack were struck by lightning, the discharge would follow the metal path, and, assuming further that the rod, tape or rope, whether of iron or copper, terminated abruptly in a filthy drain any disruptive effect would take place below ground instead of shattering the superstructure. Corroborative evidence may be recalled with advantage. In his lecture, delivered at the School of Military Engineering, Chatham (December 6th, 1906), Mr. Alfred Hands affirmed that electrically bad joints and a bad earth connection would not force the discharge to "go through the masonry. Bad joints would only cause injury to the conductor; and a 'bad' earth would probably result in a barrow load or so of soil being blown up. The concussion due to the explosive force that blew up the ground might possibly crack the masonry slightly on the surface, but this would be the worst that would happen."

Having dealt with that phase of our subject relating to buildings which escaped damage though fitted with faulty conductors, a concluding incident will be cited differing somewhat from those previously described, yet the cause was traced once more to a bad earth connection. Instructions were received to investigate a case of lightning conductor failure. As usual, there was considerable divergence of opinion respecting what had really happened, but the occupants of the premises asserted that simultaneous with a thunder crash, heavy flashes of lightning pervaded the building—fortunately leaving the structural parts intact—the lightning bolt finally plunging into the green sward beside the entrance door. After hearing this account, an exhaustive "bridge" test was made of the lightning conductor, which test gave unmistakeable evidence of high and variable resistance. Examination showed the copper rope to be free from sharp bends, and a close inspection revealed no trace of "side flash" effects. The ground was next opened out where the lightning "bolt" was alleged to have plunged; and then the source of the complaint became manifest. A large *dry* joint was found in the conductor, which lay in a subsoil devoid of moisture. Every strand was badly oxidised, and the style of joint was crude and ineffective. Presumably the contractor had miscalculated the length needed, and finding that a joint could be made out of sight he completed the order in the least inconvenient way. A more charitable interpretation would be to assume that the conductor had been snapped asunder at some time during drainage excavations, and that a temporary re-connection had been made without notification of the fact. Whichever view is the more cogent, it is safe to conclude that a complaint would never have been lodged, nor would any alarm have been experienced if the conductor had been continuous throughout its whole length.

From the particulars furnished, support is lent to the theory that the lightning stroke was due to what is technically known as "impulsive rush," there being no time for the usual brush discharge to act. The thunder cloud nearest the building became suddenly electrified by a flash from higher clouds, each one discharging into the other in rapid succession until the conductor was struck. The peal of thunder coincident with the lightning (or nearly so) was brought about by the heating effects of the electrical discharge and the rapid rush of air along the track where rarefaction had taken place.

Encountering the oxidised joint below ground, the lightning became disruptive at that point, disturbing a portion of the green sward and raising the potential of surrounding objects to an enormous degree. The phenomenon observed among the stanchions inside the building was most likely a result of the surging effect of the current, the action of which has been proved analogous to the oscillatory discharge of a Leyden jar—that is to say, the electricity flows backwards and forwards in the circuit several times before the jar or condenser becomes finally discharged.

We have tried to emphasise the importance of a good "earth" and a periodical test. Too often the work of a predecessor in lightning conductor installations is denounced by a newcomer as "all wrong," while his own accomplishments in the same direction are unquestionably "all right." Such vague generalisations are out of place at the present stage of the art. Greater exactitude is wanted. Prof. Fleeming Jenkin was not far wrong in remarking, "It is not sufficient to say under such and such conditions a current flows, or a resistance is increased. The practical electrician must know how much current and *how much resistance, or he knows nothing.*"

Eating Lead Pipe.—Electrical engineers and fire underwriters interested in the Union Stock Yards have become alarmed over the advent of unidentified larvæ, which are swarming in certain sections of the packing plants, and insist upon feeding on the lead pipe protection of electric cables. These brown, hairy little wrigglers, each ⅝ in. long, are moving through the "hoof" houses at the yard, gnawing irregular patches of lead and often cutting through cloth and rubber insulation, and short-circuiting the current. Holes 1 in. × ½ in. have been cut through lead pipe $\frac{1}{10}$ in. thick.—*Australasian Hardware and Machinery.*

Electro-Medical Apparatus.—A recent generous gift of appliances to the Royal Devon and Exeter Hospital enables that institution to undertake seven methods of treatment by electricity as follows:—Entire immersion bath with primary or secondary faradic current, sinusoidal or continuous current; ultra-violet light treatment; high-frequency current on couch or with electrodes; high-frequency with massage; four-celled Schnee bath, or limb bath for paralysis of single limbs; ionic medicinal treatment, cataphoresis baths; Finsen light treatment; and X-ray treatment.

THE PSYCHOLOGY OF THE FOLLOW-UP SYSTEM.

Electrical engineers in this country are, to certain extent, wakening up to the fact that advertising pays in connection with their undertakings. Their trouble is that they are unable from the limitations of their training and experience to determine in which direction their energies should be expended. Their literature on the subject is very largely a study as to the advertising methods of our cousins in America, and conditions in this country and that are very largely different. Added to this the attitude of the English engineer is unconsciously influenced by the fact that he knows American electrical goods to be not quite so durable and well-made as the best quality of English practice, and this attitude of mental criticism extends to his views of American commercial methods. A little reasoning would show that such methods have in the past created the sale of American articles in the country, and, therefore, the salesmanship, as apart from the goods sold, is superior to that of the British firm.

It is, therefore, interesting to find in an English paper, *The Business Man's Magazine*, hints concerning advertising which directly apply to English practice, and it will surely be a logical step to take if the electrical man adapts to his own purposes methods which have already been tried in other branches of English trade. An article by W. Arthur Procter, in the above journal, sets out at considerable length the value of the follow-up system of letter writing, and the first proposition which the writer makes is that a traveller in the form of a letter is transported hundreds of miles for a modest sum, and if the addressee is to be found, it is morally certain that the Postal authorities will find him. A man's mail will reach him where nothing else will.

The next point is that although the usual forms of advertising have reached a high standard of excellence, the follow-up system can hardly be said to have reached a passable grade of excellence excepting in the case of a few up-to-date commercial houses. This is probably because the follow-up system is only a youngster in the world of publicity as compared with advertising proper, and moreover, the value of the follow-up letter is not fully realised, inasmuch as there are many firms who work on the assumption that if Press announcements will not bring grist to the mill, nothing else will. As a matter of fact, Press announcements arouse interest and curiosity, but it is usually the follow-up letter or circular that clinches the order, or brings the inquiry that ripens into an order. One has a better chance of obtaining a man's support by taking him out of a crowd and talking to him privately, than if he were addressed without direct reference to his individuality.

The follow-up system was first introduced in connection with houses depending on orders obtained through the post, but it is now being taken up by ordinary trading houses, where direct results cannot be effected, owing to the bulk of the business passing through the hands of retailers. In other cases the follow-up letter is used in conjunction with a circularising campaign where no actual Press publicity has been carried out.

The chief thing to remember in writing such letters, is that they must during the whole course of a series of letters introduce certain lines of thought to the recipient, eventually leading to an acceptance of whatever proposition may be offered. The successful follow-up scheme will be built up with the sole aim of suggesting to the consumer that he does require certain applications of electricity; such a suggestion naturally raises mental interrogation, and this is met by adding to the follow-up literature replies to those questions that are most likely to arise. The reply given before the question is asked always carries weight. The letters must be full of terse, convincing, "reason why" arguments. The writer of successful follow-up literature should be in close touch with the sales, should have a keen knowledge of human nature, and must be a good correspondent. If there is no one on the electric supply authority's staff who combines these attributes with a knowledge of advertising, the best method is for the manager to draft a set of letters, and get an advertising specialist to polish them up and bring his knowledge of human nature and the necessities of the community to bear on the construction of such letters. The mistake should not be made of leaving the sending out of such letters to stenographers and post clerks, or of drafting insipid, forceless statements, and handing over inquiries from prospective customers to the ordinary correspondence staff. A special man should be set apart for dealing with follow-up correspondence.

The time elapsing between the dispatch of various communications and the number of follow-up letters to be sent must be settled by the supply authority as regards its individual means, paying attention to the price and object of the electricity supply to which attention is drawn, the class of consumer dealt with and the seasons at which there is likely to be a special demand. The more useful and necessary uses of electricity can be dealt with by a short series of letters, while those which are in the first place luxuries, but which later on become comparative necessities, require a longer series of letters full of descriptive matter, convincing argument and polite persuasion. There have been instances in business practice where home-made follow-up campaigns, fortified by expensive booklets, have fallen absolutely flat owing to some little flaw which would have been at once detected by a specialist. If booklets and catalogues are to be sent out in connection with letters, the literature should be illustrated, the type should be large and the matter should be well set, terse, and to the point. If possible the booklet should be capable of being slipped into the pocket, as literature arriving by the morning's post can, if of the right size, be slipped into the pocket for perusal in the train, or during the day, whereas a larger book would be poked into a drawer and forgotten.

The letters should be on good stationery, well printed or well written. No firm would send out an untidy looking traveller. The envelopes should be of good quality, and great care should be taken in dispatching them that none are sent out unstamped, or insufficiently or untidily sealed. The first letter would require to be in an envelope embossed or written with the company's name and address, but the following letters should have plain envelopes; printing on envelopes not only causes them to find the waste paper basket before being opened or read, but is likely to offend some customers who do not like their servants to know all their business. Have two or three sizes, patterns, or colours of envelopes so that the letter is not recognised before opening, and, if possible, have the envelope hand-written as there are still some people living who dislike the look of typewriting. The letter paper should always be in good taste; if at all coloured the tint should be very light, the heading should be well printed, as high-class printing or relief stamping always pays better in the long run. Include your name and address, particulars of business, branches, telephone number, and telegraphic address, but do not crowd so much into the heading that your prospective customers read the heading and forget the letter. See that the dates, names and addresses are filled in accurately and neatly by typists; a letter that a prospective customer imagines has been written personally and individually to him has 50 per cent. more force than an obvious circular. Sign the letters yourself; rubber stamp facsimiles are no use for signatures. Do not try to save a halfpenny by sending the letters in open envelopes. It is also not always advisable to adhere to the same period of time between each letter; the second letter may be sent one week after the first, the third a fortnight after the second, and the fourth a month after the third. It is no use worrying a customer incessantly for a long period, but if his interest can be aroused a long-distance follow-up letter may be dispatched. The limit as to the number of letters to be sent is fixed by the way in which the letters are prepared; it is the cheap careless form of dispatch which produces disgust, where it is desired to bring business. A well-designed poster, taking an analogous example, is always welcome and not likely to disfigure its location, but the untidy and slovenly poster gives offence to refined taste wherever it is placed. Psychologically, seven weeks is about ample time for the series of letters to run.

A useful series is that of an initial catalogue or booklet. The first follow-up letter should be short and of the nature of an inquiry as to whether the catalogue or booklet is of interest or service; if any other information may be afforded, and if the favour of an order may be expected. The second letter should contain a special inducement to adopt the scheme of electricity supply suggested; a trial installation may be offered, or anything in the nature of a virtual bonus should be suggested; possibly an order form or card containing a few printed questions bearing on the information required from the consumer should be enclosed. Time is money, and such forms are often filled in and dispatched where a letter could not or would not be written. The third letter should be a work of art; the quality of its appearance and construction must not be allowed to deteriorate materially, but rather improve upon the previous one. It is well worth while enclosing in this letter a stamped postcard or envelope for reply. The fourth letter should be brief and extremely pointed. Enclosed with these letters should be sent a series of fillers, consisting of slips of printed matter answering such questions as are likely to be raised by prospective consumers with reference to the scheme. A long-distance follower may take the form of some catch novelty in celluloid or other material, as these little novelties are often kept by reason of their usefulness.

During the course of a follow-up scheme many special replies will be received, and these must be handled carefully and discreetly; and although they may not exactly contain an order, the manner in which the inquiries are answered will practically decide whether or not business will be done. Letter writing, more especially when the communications are intended to get business, is an art, and requires something more than a good quality of grammar and euphonious construction. For example, don't talk about yourself as a supply authority, but talk about the applications of electricity; work in a personal note right through the scheme, giving each inquirer the idea that he is having your attention.

The above hints show that there is a wide and useful field for originality in follow-up letters and literature, a field that has, so far, received very scant attention. The technical man will probably have difficulty in framing such letters in simple and non-technical language, and in seeing the propositions from the consumer's point of view with sufficient rapidity to appreciate quickly objections and explain them away. In his letter explaining his propositions it is necessary to transform himself into a member of the public for a few minutes while writing, and it is here that central station engineers will appreciate the value of specialists who combine the knowledge of the technical side of the question with a sufficient appreciation of the point of view of the general public. In this country the science of technical publicity has not reached quite the same stage as it has in America, but there are one or two institutions which have taken up this question very thoroughly, and which are able to give to the central station man the right kind of follow-up literature for the pushing of electricity supply.

THE ELECTRO-TECHNICAL INDUSTRY IN PERU.*

By EMILE GUARINI.

In addition to the excellent remedies recommended for special cases, but purely palliative from a general point of view (at least in the writer's opinion), there is one which will contribute powerfully to relieving the industry of Peru. This country, in place of coal, possesses a source of power in its waterfalls which the modern engineer can utilise profitably in many cases by transforming it into electricity.

The most important American and European hydro-electric stations have been constructed during the last 20 years, as it was about 1890 that active interest was shown first in the utilisation of these resources, which Cavour imaginatively christened "white coal." In 1883 Fontaine, at the Vienna Exposition, demonstrated the practicability of electrical transmission of energy. In 1886 Deprez showed the possibility of utilising advantageously water powers by means of electricity. The following years witnessed many tentative attempts, and finally, the most audacious of all, that at Niagara in 1895. The creation of this particular station had important economic consequences throughout the surrounding region, and even elsewhere. It decided engineers and investors to exploit waterfalls. Its beneficent influence has been felt in many countries. It led to the creation of new factories, and it influenced the development of new manufacturing processes and inspired important industrial discoveries.

At the present time the hydro-electric stations are still rather scarce in South America, particularly in Peru, as there are but few locations and villages which possess installations of this character. Steam-driven electric stations are also few in number.

A short time ago I called attention to this fact, after my return from a trip in the southern part of the country, at which time I submitted the first report on the condition of the electrical industries of Peru. Electric railways have been increasing since 1904. Many lines, those from Lima to Callao, and in the seaside resorts in the neighbourhood of the capital, are at the present time in full operation. The electric line from Lima to Chorrillos has met with such favour that the steam line connecting these places is to-day almost abandoned. It is also probable that the fares will be reduced shortly, and another company has decided to construct a second railroad following the same general course, work being begun on this during the present year.

At Lima itself the street lines still employ horses, but the street railway company has come to an arrangement with the city authorities, by means of which it will adopt electric traction over its whole system. In the next two years the city system, increased by three miles, will be converted to electricity. Santa Rose, Huacho and Chiclaya are other towns which possess electric railway systems.

For supplying the light and power systems Lima possesses an installation which is probably the most remarkable in South America. This consists of two hydro-electric stations and one steam station held as a reserve. The first hydraulic station is established at the foot of the Andes and is known as the Chosica station. This utilises a fall of 150 ft., with a flow of 1,750 cb. ft. a second. The second station is at Lima, and uses a fall of 81 ft.

Chosica station is 25 miles from Lima, and uses water derived by means of a concrete conduit 650 ft. above the station. This draws water from a canal 10 ft. deep and 25 ft. wide, which terminates in a settling basin, where sand and gravel is deposited. The fall drives three generating groups, each of which consists of a Pelton wheel, 6½ ft. in diameter, driving an alternator, which delivers current at 3,300 volts. There are also two exciter groups. This current is transmitted at 33,500 volts by means of a line consisting of two circuits of copper, arranged in triangle, on white cedar poles, the height of which is about 30 ft.

The second station is fed from a reservoir with a capacity of 190,000 cb. ft., by means of a pipe 1,800 ft. long and 3¾ in. in diameter.

These two stations supply current to two sub-stations, located respectively at Miraflores and La Legua, for operating the inter-urban railway system.

At Arequipa the electric generators, supplying a current mainly for lighting, are driven by water-wheels, which receive water from the Chile River under a head of 80 ft., by means of a canal 4,200 ft. long. The mean flow of water is about 140 cb. ft. a second, corresponding to a total power of 1,413 H.P., and an effective output of 1,060 H.P. at the turbine shafts.

The station, which is operated by the Sociedad Electrica, is located at Charcana, about 7½ miles from Arequipa. This contains two turbine-driven alternators, each rated at 248 H.P., consisting of a turbine using 30 cb. ft. of water a second, connected to a monophase generator giving alternating current at 5,400 volts, 60 cycles a second. A third group, rated at 548 H.P., produces three-phase current at the same voltage and frequency, and supplies the power system during the daytime, and at night is used for assisting the lighting generators. The total output of the station is about 1,000 H.P., corresponding to 756 KW., which is transmitted to the sub-station of Arequipa by a line 400 ft. long, consisting of eight bare wires.

The fall of potential in the line is relatively large, as allowing for loss in transformation and distribution, the efficiency of which is 80 per cent., the total efficiency of the system is only 60 per cent.

On the whole, these results may be considered satisfactory, and this hydro-electric station is certainly, under present conditions, one of the best in the country.

In the Tambo Valley M. Lira owns a modest electric station driven by a water-wheel, which furnishes light for the factory buildings during the working hours, supplementing in this way the steam engines.

By moving the Arequipa station about 1,200 ft., and constructing a new canal for conducting the water, it would be easy to secure from the Chile River 4,000 H.P. at least, which would be of great value for lighting the neighbourhood, for operating railways, for furnishing motive power over a large territory, &c. The fall which could thus be utilised is about 300 ft. instead of 75 ft., as at present.

In another part of the Tambo Valley there is hydraulic power sufficient for lighting and supplying power, which might be utilised at slight cost by means of wooden water-wheels constructed on the spot. Such a system would be advantageous for that section, since labour is unskilled and transportation facilities are few.

In the factory, as well as in the field, electricity is very valuable in every way, both from the point of view of doing work, as well as hygienically. Without great expense it could be applied for heating boilers by the induction method, thus utilising old steam equipment.

MM. Romana and Lira have at the present time several miles of distributing system for agricultural work and other purposes. The author is fully persuaded that in this way the effect will be to reduce the price of labour by 10 per cent. This has been the result of the work of the two gentlemen just mentioned, who by seizing a favourable opportunity for re-equipping their factory were able to extend the system considerably.

At Mollendo the supply of potable water feeding that locality constitutes, according to E. Reclus, one of the most remarkable hydraulic works on that side of the valley. This might be used as well for driving turbines. Bustamente y Barreda, an engineer, has suggested a number of modifications for utilising this system. The canal consists of a pipe 7 in. in diameter and 86 miles long. The fall along the pipe is 7,000 ft., and the speed of flow about 2½ ft. a second, the output being 5½ gallons a second. By installing a turbine at the lower end of this pipe, it would be possible then to obtain about 425 H.P., giving, with an ordinary turbine, about 320 H.P.; but this plan is impossible because the pipe is incapable of resisting the pressure which would thus be brought to bear. In fact, it is cut into sections by a number of intermediate basins, so that the fall could be economically utilised with the present apparatus. The most simple solution would be to construct, at Mollendo, a second reservoir forming a storage basin with a capacity of 3,200 cb. ft. The discharge from this reservoir could be utilised for driving a turbine for the six hours of lighting. The height of fall thus created would be about 600 ft. The output being quadruple, if the water be utilised during six hours instead of 24, this would make 476 H.P. available, theoretically.

A hydraulic accumulator instead of storage batteries is indispensable if the plant is to be operated under the conditions suggested. This system is advantageous, and it is to be presumed that it will be frequently adopted in Peru.

* New York *Electrical Review*.

The Lighting of L.C.C. Schools.—The Education Committee of the L.C.C. reported at last week's meeting that they had for some time past had under consideration the relative merits of gas and electric lighting in schools. Gas lighting by means of plain burners had been practically superseded by the introduction of incandescent mantles, which had been found preferable from the points of view of economy and efficiency. The principal endeavour of the Committee had, therefore, been to obtain an accurate comparison of the merits of incandescent gas and electric lighting. As far as hygiene and general efficiency were concerned, electricity possessed many advantages over gas, but from comparative tables which the Committee had had before them, it would appear that the cost of maintenance was about 50 per cent. higher. The Committee were, however, informed that the present type of incandescent electric lamp was likely to be superseded in the near future by metallic filament lamps, which would effect a great saving in the consumption of current, and might render electricity a cheaper illuminant than gas.

A Heavy Death Roll.—The New York City Public Service Commission has compiled a table of accidents taking place on the surface, elevated and subway lines of the city, for the month of September, as made up from the reports which, under the new law, all companies operating under its jurisdiction, are obliged to submit. Fifty-six persons were killed and 208 seriously injured. Of casualties of all kinds there appear to have been no fewer than 4,906, but this was smaller than in August.—*Electrical World.*

Eiffel Tower Time.—According to the *Electrical World*, the Eiffel Tower has been utilised for public time service; a set of electric numerals, changing every minute, has been installed high up on the tower, and tells the time at night not only to all Paris, but far beyond the city limits. Unfortunately, such an indicator cannot be made visible at an equal distance in the daytime.

NEW PATENTS APPLIED FOR, 1907.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

7,941A. "Improvements in electric arc lamps." H. Bevis and A. E. Angold. (Date applied for under Rule 5 of the Patents Rules, 1905, April 5th, 1907.) October 21st.

23,152. "Portable fire alarm (electric)." G. T. Simmons. October 21st.

23,161. "Improvements in or relating to plating vats for rims and the like." W. Pears and W. J. Butlin. October 21st.

23,199. "Improvements in and relating to arc lamps." D. Timar and K. von Dreger. (Date applied for under Patents Act, 1901, September 4th, 1907, being date of application in Germany.) October 21st. (Complete.)

23,206. "Improved hanger for the overhead wires of electric cars." D. Amos and A. M. Carroll. October 21st.

23,215. "Electric arc lamp." Deutsche Beck-Bogenlampen-Ges.m.b.H. (Date applied for under Patents Act, 1901, October 20th, 1906, being date of application in Germany.) October 21st. (Complete.)

23,216. "Improved means in connection with electric circuits, for altering the difference of potential of two points of a circuit between which a practically constant current has to flow." Felten & Guilleaume Lahmeyer-Werke-Act.Ges. (Date applied for under Patents Act, 1901, October 19th, 1906, being date of application in Germany.) October 21st. (Complete.)

23,224. "Improved means for obtaining motive power for single-phase circuits." V. A. Fynn. October 21st.

23,225. "Improvements in and relating to arc lamps." D. Timar and K. von Dreger. (Date applied for under Patents Act, 1901, September 6th, 1907, being date of application in Germany.) October 21st. (Complete.)

23,230. "Improvements in devices for controlling electric circuits." British Thomson-Houston Co., Ltd.) General Electric Co., United States. October 21st.

23,231. "Improvements in adjuncts for aluminium cell lightning arresters." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) October 21st.

23,239. "Improvements relating to electric switches." C. N. Bergmann. October 21st. (Complete.)

23,273. "Improvements in electric insulating materials." J. Hargreaves. October 22nd.

23,280. "Improvements in and relating to the protection of electric circuits." C. C. Garrard and Ferranti, Ltd. October 22nd.

23,290. "Improvements in or relating to ignition devices." F. J. Luke. October 22nd.

23,294. "Improved contact for the trembler or vibrator and adjusting screw of induction coils and the like." A. E. Lamkin and E. T. Crofts. October 22nd.

23,303. "Improvements in electric lifts." C. G. Major, E. C. Stevens and P. H. Stevens. October 22nd.

23,311. "Electro-mechanical means for controlling belt gearing." W. E. Clark. October 22nd.

23,318. "Improvements in magnet inductors furnished with pole armatures." Hartmann & Braun Akt.-Ges. (Date applied for under Patents Act, 1901, October 24th, 1906, being date of application in Germany.) October 22nd. (Complete.)

23,329. "Improvements in means for causing an electric current of variable direction to flow always in one direction only." Felten & Guilleaume Lahmeyer-Werke Akt.-Ges. (Date applied for under Patents Act, 1901, October 22nd, 1906, being date of application in Germany.) October 22nd. (Complete.)

23,351. "Improvements in electric search-lights." Gebruder Siemens and Co. (Date applied for under Patents Act, 1901, November 6th, 1906, being date of application in Germany.) October 22nd. (Complete.)

23,353. "Improvements in protective devices for electric conductors and systems." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) October 22nd.

23,358. "Improvement in enclosed arc lamps." C. Petitjean. October 23rd.

23,386. "Improvements in cable relays." I. Kitsee. October 23rd. (Complete.)

23,404. "Improvements in or relating to protective devices against infection for telephonic or the like apparatus." A. Pick and S. Pick. October 23rd.

23,416. "Improvements in electrically-controlled pendulums." C. Fery. (Date applied for under Patents Act, 1901, March 1st, 1907, being date of application in France.) October 23rd. (Complete.)

23,418. "Turn-down device for low voltage incandescent lamps." H. W. Turner. October 23rd.

23,429. "Improvements in and relating to electrodes for electric arc lamps." E. R. Grote and The Foster Arc Lamp and Engineering Co., Ltd. October 23rd. (Complete.)

23,432. "Improvements in or relating to alternating electric current distributing systems." G. Berry. October 23rd.

23,435. "Improvements relating to electric incandescent lamps." A. D. Williamson. October 23rd.

23,440. "Improved electric switch." J. W. Ewart and W. Seal. October 23rd.

23,441. "Improved electrical sound intensifier." A. Von Nikiforoff. October 23rd.

23,448. "Improvements in alternating-current commutating electric machines." Allgemeine Elektricitats Ges. (Date applied for under Patents Act, 1901, October 24th, 1906, being date of application in Germany.) October 23rd. (Complete.)

23,449. "Improvements in electric switches or circuit-breakers." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) October 23rd.

23,456. "Improvements in and relating to prepayment electric meters." E. Schattner and R. Amberton. October 23rd.

23,456. "Timing the spark of magnetos and the like." S. Griffin. October 24th.

23,497. "Spring support for an electric motor arranged on the axle of a vehicle." Siemens-Schuckertwerke G.m.b.H. (Date applied for under Patents Act, 1901, October 25th, 1906, being date of application in Germany.) October 24th. (Complete.)

23,500. "Galvanic sock." J. V. Danis and F. Kennedy. October 24th. (Complete.)

23,506. "Mechanical and electrical revolving advertising lamp." C. W. Freeman. October 24th.

23,520. "Improvements in and relating to the control of electric motors." British Thomson-Houston Co., Ltd. (Allgemeine Elektricitäts Ges., Germany.) October 24th.

23,531. "Improvements in and relating to apparatus for the production of vibrations." J. Astrom and S. Newman. October 24th. (Complete.)

23,544. "Process of using electricity in the malting or the manufacture or the making of barley or other grain into malt, and in the brewing of ales, beers, stouts, or porters from malt hops, grain or sugar (or any other substance) in any form or manner whatsoever." B. Combe. October 25th.

23,554. "Improvements in or connected with electric cables." J. N. D. Burgess. October 25th.

23,562. "Improvements in ceiling roses used in connection with electric lamps." P. T. Barlow. October 25th.

23,586. "Automatic electric signalling device for electric tramways and railways." H. Brown. October 25th.

23,585. "Method of producing electric illuminating bodies by causing raw metallic threads to become incandescent by means of the electric current." Gluhlampenwerk Anker G.m.b.H. (Date applied for under Patents Act, 1901, May 2nd, 1907, being date of application in Germany.) October 25th. (Complete.)

23,586. "Galvanic element and method of manufacturing the same." S. A. Weman. (Date applied for under Patents Act, 1901, October 27th, 1906, being date of application in Sweden). October 25th. (Complete.)

23,603. "Improvements in or relating to electro-magnetic winding gear for clocks or the like." A. J. Boult. (Normal-Zeit G.m.b.H., Germany.) October 25th. (Complete.)

23,609. "Improvements in electric signalling systems." H. E. Lake. (International Telemeter Co., United States.) October 25th. (Complete.)

23,618. "Apparatus for connecting conducting and other wires." A. Fodor. October 25th. (Complete.)

23,641. "Improvements in or relating to electric light pendants." H. W. Hanwell. October 25th. (Complete.)

23,647. "The harnessing of electrical and thermal sources of energy for the cultivation of organic vegetable matter." B. H. Thwaite. October 26th.

23,681. "Improvements in electric contact or connecting plugs." W. P. Steinthal and L. Jessop. October 26th. (Complete.)

23,707. "Improvements in and relating to the control of alternating electric current motors." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) October 26th.

23,708. "Improvements in and relating to the control of alternating current electric motors." British Thomson-Houston Co., Ltd. (General Electric Co., United States.)

23,709. "Improvements in dynamo-electric machines." L. E. Underwood and C. P. Smith. (Date applied for under Patents Act, 1901, October 27th, 1906, being date of application in United States.) October 26th. (Complete.)

23,710. "Improvements in dynamo-electric machines." H. G. Reist. (Date applied for under Patents Act, 1901, October 26th, 1906, being date of application in United States.) October 26th. (Complete.)

23,711. "Improvements in the manufacture of electric conductors of refractory metal applicable more especially for use as incandescing bodies in electric lamps and other apparatus." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) October 26th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool price, post free, 9d. (in stamps).

1906.

Telephonic Exchange Switchboards. E. A. Graham. 14,804. June 28th.

Refractory Conductors for Use in Electric Lamps, Furnaces or other Apparatus. British Thomson-Houston Co. (General Electric Co., United States.) 19,398. August 30th.

Insulating Composition for Use as a Filling Material within Troughs and other Conduits Containing Electric Cables. J. Johnson and J. Titley. 21,290. September 26th.

Manufacture of Electric Conductors of Refractory Metal, Applicable more Especially for Use as Incandescing Bodies in Electric Lamps and other Apparatus. British Thomson-Houston Co. (General Electric Co., United States.) 21,505. September 28th.

Manufacture of Electric Conductors of Refractory Metals. British Thomson-Houston Co. (General Electric Co., United States.) 21,509. September 28th.

Electrodes for Electric Arc Lamps, and Methods of Making the Same. British Thomson-Houston Co. (General Electric Co., United States). 21,510. September 28th.

Fittings for Electrical Conduits. J. W. Brooks and H. E. Read. 21,604. October 1st.

Receiving Devices for Electric Telegraphs. I. Kitsee. 21,623. October 1st.

Telephonic Store-Service and Credit-Checking Apparatus. National Cash Register Co. (National Cash Register Co., United States.) 21,872. October 3rd.

Party-Line Telephone Systems. Select Telephone Manufacturing Co. and W. M. Bruce, Jun. 22,113. October 6th.

Electric Motor Controlling Apparatus. F. Krizek. 22,217. October 8th.

Contact-Breaking Appliances Used in Electric Ignition Apparatus of Internal Combustion Motors. Austin Motor Co. and H. Austin. 22,944. October 17th.

Ignition Apparatus for Internal Combustion Engines. E. Gosset, G. Tanner and R. T. Deane. 24,291. October 31st.

Electric Bells. H. Bevis and A. E. Mitchell. 24,727. November 5th.

Terminal Connections for Electric Conductors. G. E. Osmond. 26,663. November 23rd.

Method of and Means for Effecting Ignition in Internal Combustion Motors. W. A. Trier. 28,446. December 12th.

1907.

Photometer for Testing the Luminous Power of Electric Lamps. G. Bartels. 13,062. June 5th.

Electric Hand Lamps. A. Loebl and the British Ever-Ready Electrical Co. 17,067. July 25th.

Controllers for the Trolley Poles of Electric Cars. A. J. Edwards. 453. January 7th.

Liquid Electrical Controllers. H. Richardson, C. E. Cooke and South Durham Steel & Iron Co. 640. January 10th.

Arrangement for Indicating and Recording Permanently the Maximum Demand for Electrical Energy on any Circuit. W. W. Lackie and D. J. Steele. 2,551. February 1st.

Troughing or Conduit for Underground Electrical Conductors. A. E. H. Dussek and A. S. Dussek. 4,499. February 23rd.

Method for Producing Undamped Electric Oscillations by means of the Flame Arc Produced by Electric Arc Lamps or the like. W. P. Thompson. (Ges. für drahtlose Telegraphie.) 7,815. April 3rd.

Wireless Telegraphy. I. J. Murgas. 9,726. April 26th.

Interrupter for Magneto-Electric Ignition Apparatus. G. A. Unterberg and F. Helmle, trading as the firm of Unterberg & Helmle. 10,136. May 1st. (Date applied for under International Convention, August 11th, 1906.)

Electrical Contacts. J. H. Robertson and J. C. Klatzl. 10,514. May 6th.

Telephone Transmitters. S. C. Houghton. 10,537. May 6th.

Electro-Magnetic Brakes for Railway and other Vehicles. R. Braun. 10,709. May 8th. (Date applied for under International Convention, May 18th, 1906.)